

EXHIBIT D

Part 1 of 2

File History Report

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- ☐ PTO 892
- ☐ PTO 948
- ☐ PTO 1449
- ☐ PTO 1474
- ☐ Assignment

Additional comments

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7,179,046

FAN ARRAY FAN SECTION IN AIR-HANDLING SYSTEMS

Transaction History

Date	Transaction Description
6/15/2005	Information Disclosure Statement considered
6/15/2005	Reference capture on IDS
6/15/2005	Information Disclosure Statement (IDS) Filed
6/15/2005	Information Disclosure Statement (IDS) Filed
6/15/2005	Initial Exam Team nn
6/24/2005	IFW Scan & PACR Auto Security Review
6/29/2005	Cleared by OIPE CSR
7/12/2005	Application Dispatched from OIPE
7/12/2005	Application Is Now Complete
1/12/2006	Correspondence Address Change
1/12/2006	Change in Power of Attorney (May Include Associate POA)
1/17/2006	Information Disclosure Statement considered
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1/17/2006	Information Disclosure Statement (IDS) Filed
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2/27/2006	Information Disclosure Statement considered
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3/6/2006	Non-Final Rejection
3/8/2006	Mail Non-Final Rejection
9/11/2006	Terminal Disclaimer Filed
9/11/2006	Response after Non-Final Action
9/11/2006	Request for Extension of Time - Granted
9/21/2006	Date Forwarded to Examiner
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12/6/2006	Receipt into Pubs
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12/12/2007	Correspondence Address Change

Part of Paper No. 03062006

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Index of Claims 	Application/Control N .		Applicant(s)/Patent under Reexamination
	11/154,894		HOPKINS, LAWRENCE G.
	Examiner		Art Unit
	Ninh H. Nguyen		3745

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Issue Classification 	Application/Control No. 11/154,894	Applicant(s)/Patent under Reexamination HOPKINS, LAWRENCE G.
	Examiner Ninh H. Nguyen	Art Unit 3745

ISSUE CLASSIFICATION																			
ORIGINAL					INTERNATIONAL CLASSIFICATION														
CLASS		SUBCLASS			CLAIMED					NON-CLAIMED									
415		61			F	04	D	25	/16					/					
CROSS REFERENCES									/					/					
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(Assistant Examiner) (Date) (Legal Instruments Examiner) (Date)					NINH H. NGUYEN PRIMARY EXAMINER (Primary Examiner) (Date)					Total Claims Allowed: 19 O.G. Print Claim(s) 1					O.G. Print Fig. 14, 17				

<input type="checkbox"/> Claims renumbered in the same order as presented by applicant				<input type="checkbox"/> CPA				<input type="checkbox"/> T.D.				<input type="checkbox"/> R.1.47			
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US007179046B2

(12) **United States Patent**
Hopkins

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(45) **Date of Patent:** ***Feb. 20, 2007**

(54) **FAN ARRAY FAN SECTION IN**
AIR-HANDLING SYSTEMS

(75) **Inventor:** **Lawrence G. Hopkins, Portland, OR**
(US)

(73) **Assignee:** **Huntair Inc., Tualatin, OR (US)**

(*) **Notice:** Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 0 days.

This patent is subject to a terminal disclaimer.

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Related U.S. Application Data

- (63) Continuation of application No. 10/806,775, filed on Mar. 22, 2004, now Pat. No. 7,137,775, and a continuation-in-part of application No. PCT/US2004/008578, filed on Mar. 19, 2004.
(60) Provisional application No. 60/554,702, filed on Mar. 20, 2004, provisional application No. 60/456,413, filed on Mar. 20, 2003

(51) **Int. Cl.**
F04D 25/16 (2006.01)

(52) **U.S. Cl.** 415/61; 415/119; 416/120;
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(58) **Field of Classification Search** 415/60,
415/61, 108, 177, 119; 416/120; 417/3,
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See application file for complete search history.

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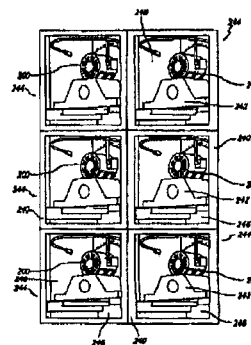
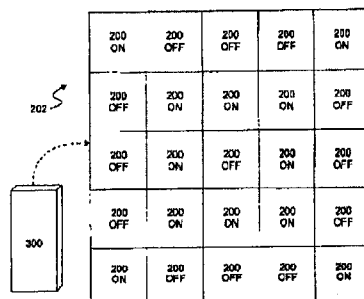
Primary Examiner—Ninh H. Nguyen

(74) *Attorney, Agent, or Firm* Chernoff, Vilhauer,
McClung & Stenzel, LLP

(57) **ABSTRACT**

A fan array fan section in an air-handling system includes a plurality of fan units arranged in a fan array and positioned within an air-handling compartment. One preferred embodiment may include an array controller programmed to operate the plurality of fan units at peak efficiency. The plurality of fan units may be arranged in a true array configuration, a spaced pattern array configuration, a checker board array configuration, rows slightly offset array configuration, columns slightly offset array configuration, or a staggered array configuration.

19 Claims, 15 Drawing Sheets



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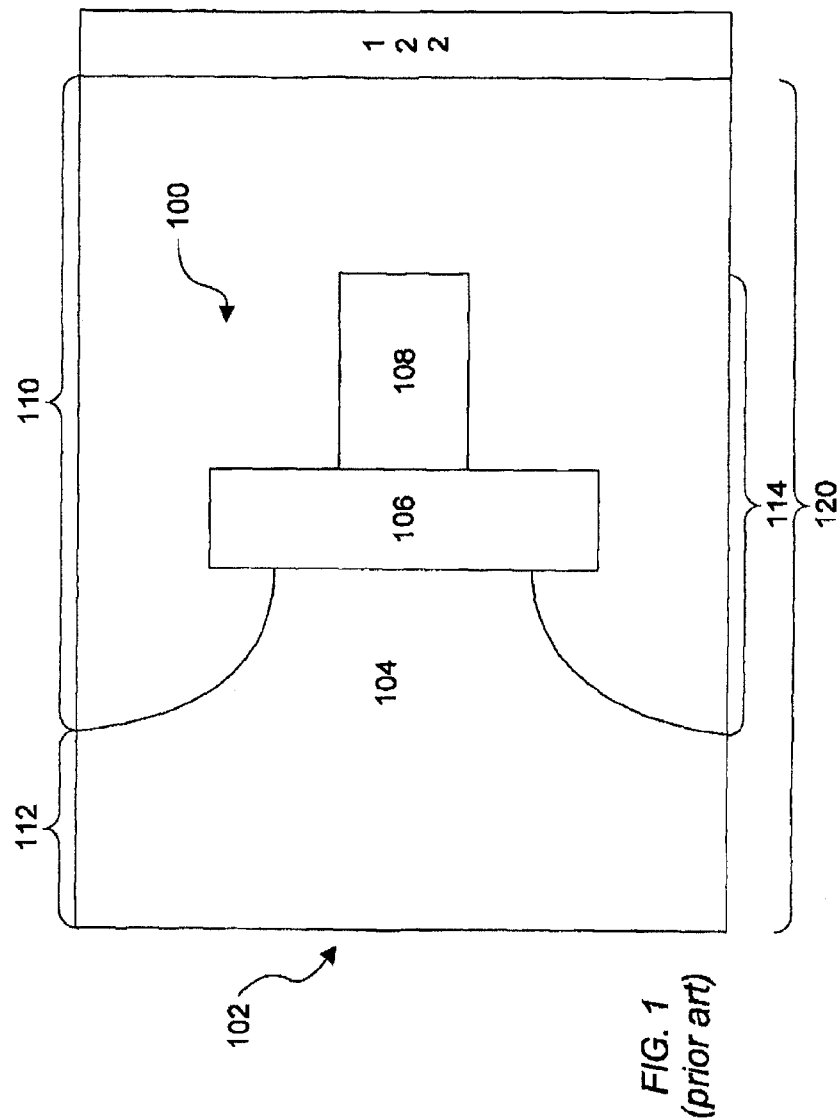
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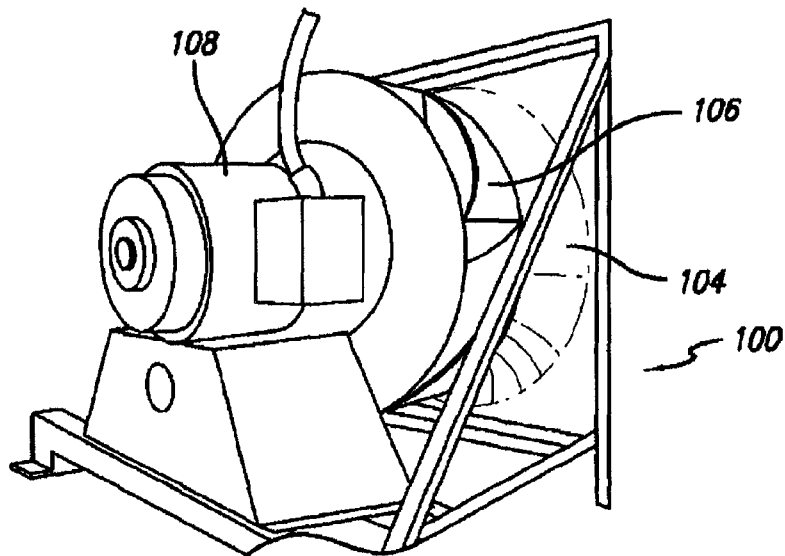


FIG. 2
(prior art)

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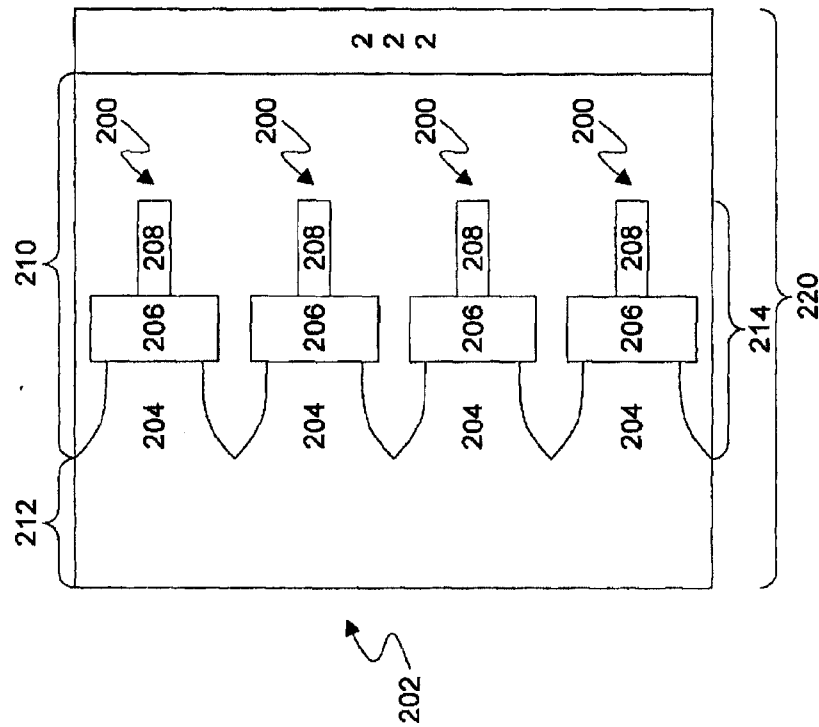


FIG. 3

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FIG. 4

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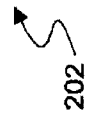
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FIG. 5



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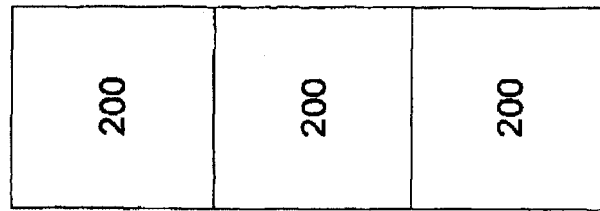
FIG. 6

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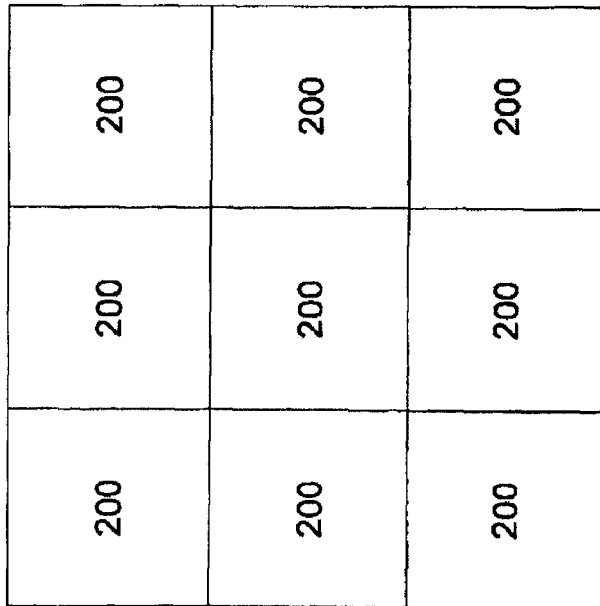
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FIG. 8



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FIG. 7

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FIG. 10

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FIG. 9

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FIG. 11

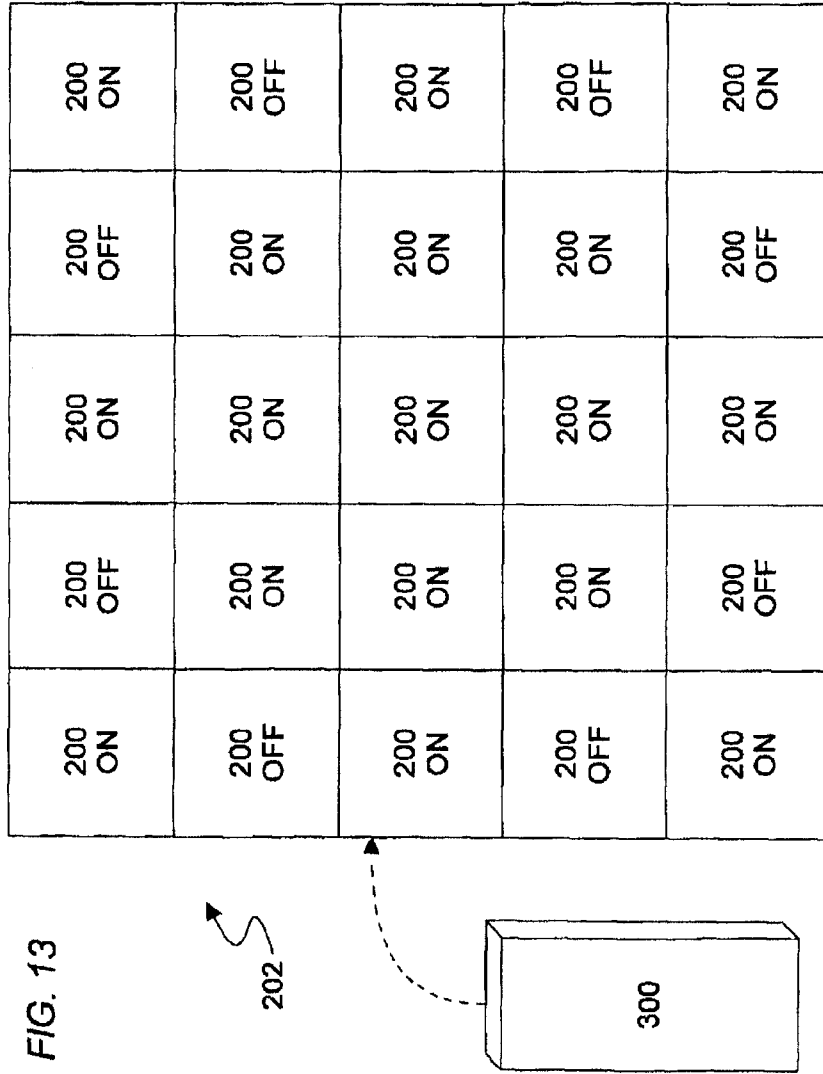


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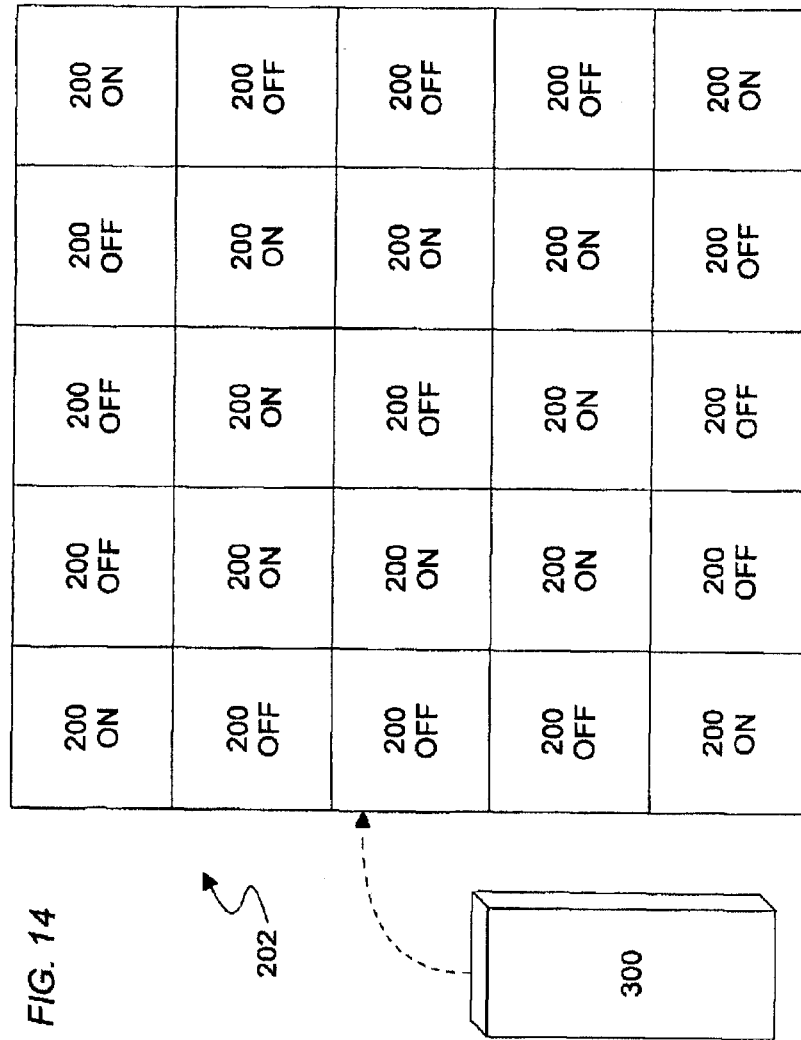


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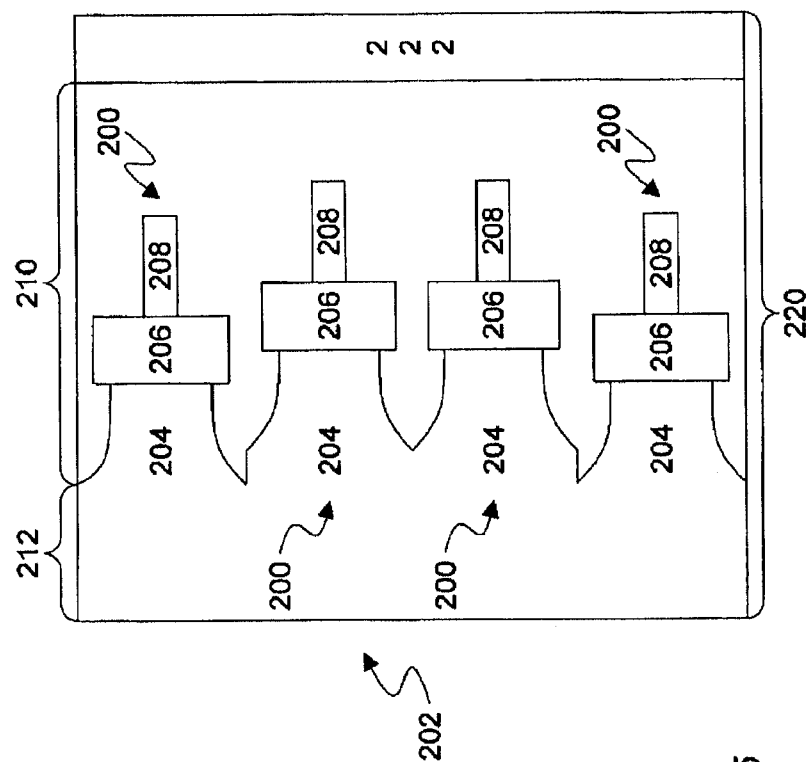


FIG. 15

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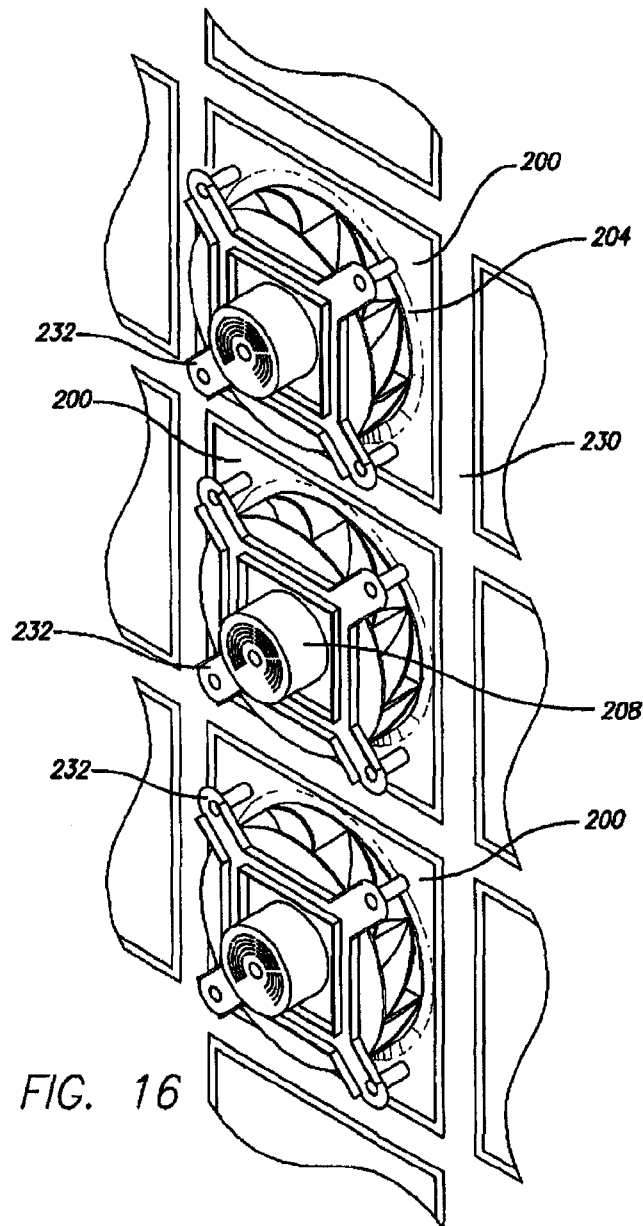


FIG. 16

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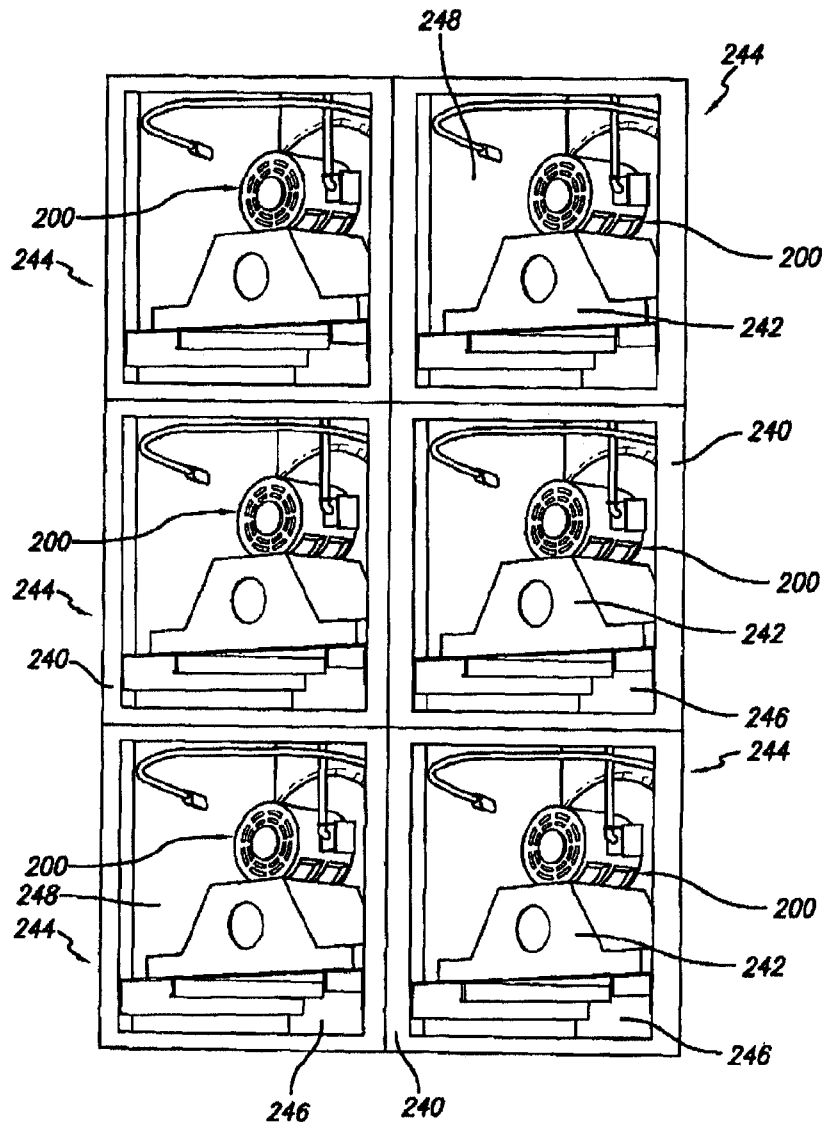


FIG. 17

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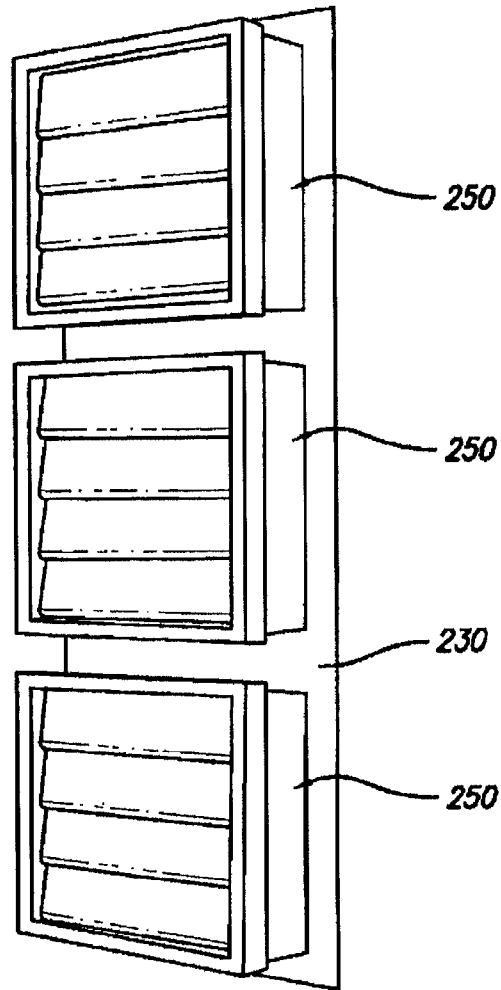


FIG. 18

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1 FAN ARRAY FAN SECTION IN AIR-HANDLING SYSTEMS

The present application is a continuation application of U.S. patent application Ser. No. 10/806,775, filed Mar. 22, 2004 now U.S. Pat. No. 7,137,775, and entitled FAN ARRAY FAN SECTION IN AIR-HANDLING SYSTEMS. U.S. patent application Ser. No. 10/806,775 is a nonprovisional application claiming the benefit under 35 USC Section 119(c) of U.S. Provisional Patent Application Ser. No. 60/554,702, filed Mar. 20, 2004, and entitled FAN ARRAY FAN SECTION IN AIR-HANDLING SYSTEMS. U.S. patent application Ser. No. 10/806,775 is a nonprovisional application claiming the benefit under 35 USC Section 119(e) of U.S. Provisional Patent Application Ser. No. 60/456,413, filed Mar. 20, 2003, and entitled FAN ARRAY FAN SECTION IN AIR-HANDLING SYSTEMS. U.S. patent application Ser. No. 10/806,775 is a continuation-in-part application of PCT Patent Application Serial Number PCT/US2004/008578, filed Mar. 19, 2004, and entitled FAN ARRAY FAN SECTION IN AIR-HANDLING SYSTEMS. The present application is based on and claims priority from these applications, the disclosures of which are hereby expressly incorporated herein by reference.

BACKGROUND OF INVENTION

The present invention is directed to a fan array fan section utilized in an air-handling system.

Air-handling systems (also referred to as an air handler) have traditionally been used to condition buildings or rooms (hereinafter referred to as "structures"). An air-handling system is defined as a system that includes components designed to work together in order to condition air as part of the primary system for ventilation of structures. The air-handling system may contain components such as cooling coils, heating coils, filters, humidifiers, fans, sound attenuators, controls, and other devices functioning to meet the needs of the structures. The air-handling system may be manufactured in a factory and brought to the structure to be installed or it may be built on site using the necessary devices to meet the functioning needs of the structure. The air-handling compartment 102 of the air-handling system includes the inlet plenum 112 prior to the fan inlet cone 104 and the discharge plenum 110. Within the air-handling compartment 102 is situated the fan unit 100 (shown in FIGS. 1 and 2 as an inlet cone 104, a fan 106, and a motor 108), fan frame, and any appurtenance associated with the function of the fan (e.g. dampers, controls, settling means, and associated cabinetry). Within the fan 106 is a fan wheel (not shown) having at least one blade. The fan wheel has a fan wheel diameter that is measured from one side of the outer periphery of the fan wheel to the opposite side of the outer periphery of the fan wheel. The dimensions of the handling compartment 102 such as height, width, and airway length are determined by consulting fan manufacturers data for the type of fan selected.

FIG. 1 shows an exemplary prior art air-handling system having a single fan unit 100 housed in an air-handling compartment 102. For exemplary purposes, the fan unit 100 is shown having an inlet cone 104, a fan 106, and a motor 108. Larger structures, structures requiring greater air volume, or structures requiring higher or lower temperatures have generally needed a larger fan unit 100 and a generally correspondingly larger air-handling compartment 102.

As shown in FIG. 1, an air-handling compartment 102 is substantially divided into a discharge plenum 110 and an

inlet plenum 112. The combined discharge plenum 110 and the inlet plenum 112 can be referred to as the airway path 120. The fan unit 100 may be situated in the discharge plenum 110 as shown, the inlet plenum 112, or partially within the inlet plenum 112 and partially within the discharge plenum 110. The portion of the airway path 120 in which the fan unit 100 is positioned may be generically referred to as the "fan section" (indicated by reference numeral 114). The size of the inlet cone 104, the size of the fan 106, the size of the motor 108, and the size of the fan frame (not shown) at least partially determine the length of the airway path 120. Filter banks 122 and/or cooling coils (not shown) may be added to the system either upstream or downstream of the fan units 100.

For example, a first exemplary structure requiring 50,000 cubic feet per minute of air flow at six (6) inches water gage pressure would generally require a prior art air-handling compartment 102 large enough to house a 55 inch impeller, a 100 horsepower motor, and supporting framework. The prior art air-handling compartment 102, in turn would be approximately 92 inches high by 114 to 147 inches wide and 106 to 112 inches long. The minimum length of the air-handling compartment 102 and/or airway path 120 would be dictated by published manufacturers data for a given fan type, motor size, and application. Prior art cabinet sizing guides show exemplary rules for configuring an air-handling compartment 102. These rules are based on optimization, regulations, and experimentation.

For example, a second exemplary structure includes a recirculation air handler used in semiconductor and pharmaceutical clean rooms requiring 26,000 cubic feet per minute at two (2) inches water gage pressure. This structure would generally require a prior art air-handling system with a air-handling compartment 102 large enough to house a 44 inch impeller, a 25 horsepower motor, and supporting framework. The prior art air-handling compartment 102, in turn would be approximately 78 inches high by 99 inches wide and 94 to 100 inches long. The minimum length of the air-handling compartment 102 and/or airway path 120 would be dictated by published manufacturers data for a given fan type, motor size and application. Prior art cabinet sizing guides show exemplary rules for configuring an air-handling compartment 102. These rules are based on optimization, regulations, and experimentation.

These prior art air-handling systems have many problems including the following exemplary problems:

Because real estate (e.g. structure space) is extremely expensive, the larger size of the air-handling compartment 102 is extremely undesirable.

The single fan units 100 are expensive to produce and are generally custom produced for each job.

Single fan units 100 are expensive to operate.

Single fan units 100 are inefficient in that they only have optimal or peak efficiency over a small portion of their operating range.

If a single fan unit 100 breaks down, there is no air conditioning at all.

The low frequency sound of the large fan unit 100 is hard to attenuate.

The high mass and turbulence of the large fan unit 100 can cause undesirable vibration.

Height restrictions have necessitated the use of air-handling systems built with two fan units 100 arranged horizontally adjacent to each other. It should be noted, however, that a good engineering practice is to design air handler cabinets and discharge plenums 110 to be symmetrical to facilitate more uniform air flow across the width and height

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of the cabinet. Twin fan units 100 have been utilized where there is a height restriction and the unit is designed with a high aspect ratio to accommodate the desired flow rate. As shown in the Greenheck "Installation Operating and Maintenance Manual," if side-by-side installation was contemplated, there were specific instructions to arrange the fans such that there was at least one fan wheel diameter spacing between the fan wheels and at least one-half a fan wheel diameter between the fan and the walls or ceilings. The Greenheck reference even specifically states that arrangements "with less spacing will experience performance losses." Normally, the air-handling system and air-handling compartment 102 are designed for a uniform velocity gradient of 500 feet per minute velocity in the direction of air flow. The two fan unit 100 air-handling systems, however, still substantially suffered from the problems of the single unit embodiments. There was no recognition of advantages by increasing the number of fan units 100 from one to two. Further, the two fan unit 100 section exhibits a non-uniform velocity gradient in the region following the fan unit 100 that creates uneven air flow across filters, coils, and sound attenuators.

It should be noted that electrical devices have taken advantage of multiple fan cooling systems. For example, U.S. Pat. No. 6,414,845 to Bonet uses a multiple-fan modular cooling component for installation in multiple component-bay electronic devices. Although some of the advantages realized in the Bonet system would be realized in the present system, there are significant differences. For example, the Bonet system is designed to facilitate electronic component cooling by directing the output from each fan to a specific device or area. The Bonet system would not work to direct air flow to all devices in the direction of general air flow. Other patents such as U.S. Pat. No. 4,767,262 to Simon and U.S. Pat. No. 6,388,880 to El-Ghobashy et al. teach fan arrays for use with electronics.

Even in the computer and machine industries, however, operating fans in parallel is taught against as not providing the desired results except in low system resistance situations where fans operate in near free delivery. For example, Sunon Group has a web page in which they show two axial fans operating in parallel, but specifically state that if "the parallel fans are applied to the higher system resistance that [an] enclosure has, . . . less increase in flow results with parallel fan operation." Similar examples of teaching against using fans in parallel are found in an article accessible from HighBeam Research's library (<http://stat1.highbcam.com>) and an article by Ian McLeod accessible at (<http://www.papstplc.com>).

BRIEF SUMMARY OF THE INVENTION

The present invention is directed to a fan array fan section in an air-handling system that includes a plurality of fan units arranged in a fan array and positioned within an air-handling compartment. One preferred embodiment may include an array controller programmed to operate the plurality of fan units at peak efficiency. The plurality of fan units may be arranged in a true array configuration, a spaced pattern array configuration, a checker board array configuration, rows slightly offset array configuration, columns slightly offset array configuration, or a staggered array configuration.

The foregoing and other objectives, features, and advantages of the invention will be more readily understood upon

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consideration of the following detailed description of the invention, taken in conjunction with the accompanying drawings.

BRIEF DESCRIPTION OF THE SEVERAL VIEWS OF THE DRAWINGS

FIG. 1 is a side view of an exemplary prior art air-handling system having a single large fan unit within an air-handling compartment.

FIG. 2 is a perspective view of an exemplary prior art large fan unit.

FIG. 3 is a side view of an exemplary fan array fan section in an air-handling system of the present invention having a plurality of small fan units within an air-handling compartment.

FIG. 4 is a plan or elevation view of a 4x6 exemplary fan array fan section in an air-handling system of the present invention having a plurality of small fan units within an air-handling compartment.

FIG. 5 is a plan or elevation view of a 5x5 exemplary fan array fan section in an air-handling system of the present invention having a plurality of small fan units within an air-handling compartment.

FIG. 6 is a plan or elevation view of a 3x4 exemplary fan array fan section in an air-handling system of the present invention having a plurality of small fan units within an air-handling compartment.

FIG. 7 is a plan or elevation view of a 3x3 exemplary fan array fan section in an air-handling system of the present invention having a plurality of small fan units within an air-handling compartment.

FIG. 8 is a plan or elevation view of a 3x1 exemplary fan array fan section in an air-handling system of the present invention having a plurality of small fan units within an air-handling compartment.

FIG. 9 is a plan or elevation view of an alternative exemplary fan array fan section in an air-handling system of the present invention in which a plurality of small fan units are arranged in a spaced pattern array within an air-handling compartment.

FIG. 10 is a plan or elevation view of an alternative exemplary fan array fan section in an air-handling system of the present invention in which a plurality of small fan units are arranged in a checker board array within an air-handling compartment.

FIG. 11 is a plan or elevation view of an alternative exemplary fan array fan section in an air-handling system of the present invention in which a plurality of small fan units are arranged in rows slightly offset array within an air-handling compartment.

FIG. 12 is a plan or elevation view of an alternative exemplary fan array fan section in an air-handling system of the present invention in which a plurality of small fan units are arranged in columns slightly offset array within an air-handling compartment.

FIG. 13 is a plan or elevation view of a 5x5 exemplary fan array fan section in an air-handling system of the present invention running at 52% capacity by turning a portion of the fans on and a portion of the fans off.

FIG. 14 is a plan or elevation view of a 5x5 exemplary fan array fan section in an air-handling system of the present invention running at 32% capacity by turning a portion of the fans on and a portion of the fans off.

FIG. 15 is a side view of an alternative exemplary fan array fan section in an air-handling system of the present

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invention having a plurality of staggered small fan units within an air-handling compartment.

FIG. 16 is a perspective view of an exemplary fan array using a grid system into which fan units are mounted.

FIG. 17 is a perspective view of an exemplary fan array using a grid system or modular units each of which includes a fan unit mounted within its own fan unit chamber.

FIG. 18 is a perspective view of an exemplary array of dampeners that may be positioned either in front of or behind the fan units

DETAILED DESCRIPTION OF THE INVENTION

The present invention is directed to a fan array fan section in an air-handling system. As shown in FIGS. 3-12, the fan array fan section in the air-handling system uses a plurality of individual single fan units 200. In one preferred embodiment, the fan units 200 are arranged in a true array (FIGS. 4-8), but alternative embodiments may include, for example, alternative arrangements such as in a spaced pattern (FIG. 9), a checker board (FIG. 10), rows slightly offset (FIG. 11), or columns slightly offset (FIG. 12). As the present invention could be implemented with true arrays and/or alternative arrays, the term "array" is meant to be comprehensive.

The fan units 200 in the fan array of the present invention may be spaced as little as 20% of a fan wheel diameter. Optimum operating conditions for a closely arranged array may be found at distances as low as 30% to 60% of a fan wheel diameter. By closely spacing the fan units 200, more air may be moved in a smaller space. For example, if the fan wheels of the fan units 200 have a 20 inch fan wheel diameter, only a 4 inch space (20%) is needed between the outer periphery of one fan wheel and the outer periphery of the adjacent fan wheel (or a 2 inch space between the outer periphery of a fan wheel and an adjacent wall or ceiling).

By using smaller fan units 200 it is possible to support the fan units 200 with less intrusive structure (fan frame). This can be compared to the large fan frame that supports prior art fan units 100 and functions as a base. This large fan frame must be large and sturdy enough to support the entire weight of the prior art fan units 100. Because of their size and position, the known fan frames cause interference with air flow. In the preferred embodiment, therefore, the fan units 200 of the fan array may be supported by a frame that supports the motors 108 with a minimum restriction to air flow.

As mentioned in the Background, others have tried using side-by-side installation of two fan units 100 arranged horizontally adjacent to each other within an air-handling system. As is also mentioned in the Background, fan arrays have been used in electronic and computer assemblies. However, in the air-handling system industry, it has always been held that there must be significant spacing between the horizontally arranged fan wheels and that arrangements with less spacing will experience performance losses. A single large fan moves all the air in a cabinet. Using two of the same or slightly smaller fans caused the air produced by one fan to interfere with the air produced by the other fan. To alleviate the interference problem, the fans had to be spaced within certain guidelines—generally providing a clear space between the fans of a distance of at least one wheel diameter (and a half a wheel diameter to an adjacent wall). Applying this logic, it would not have made sense to add more fans. And even if additional fans had been added, the spacing would have continued to be at least one wheel diameter

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between fans. Further, in the air-handling system industry, vertically stacking fan units would have been unthinkable because the means for securing the fan units would not have been conducive to such stacking (they are designed to be positioned on the floor only).

It should be noted that the plenum fan is the preferred fan unit 200 of the present invention. In particular, the APF-121, APF-141, APF-161, and APF-181 plenum fans (particularly the fan wheel and the fan cone) produced by Twin City Fan Companies, Ltd. of Minneapolis, Minn., U.S. has been found to work well. The reason that plenum fans work best is that they do not produce points of high velocity such as those produced by axial fans and housed centrifugal fans and large plenum fans. Alternative embodiments use known fan units or fan units yet to be developed that will not produce high velocity gradients in the direction of air flow. Still other embodiments, albeit less efficient, use fan units such as axial fans and/or centrifugal housed fans that have points of high velocity in the direction of air flow.

In the preferred embodiment, each of the fan units 200 in the fan array fan section in the air-handling system is controlled by an array controller 300 (FIGS. 13 and 14). In one preferred embodiment, the array controller 300 may be programmed to operate the fan units 200 at peak efficiency. In this peak efficiency embodiment, rather than running all of the fan units 200 at a reduced efficiency, the array controller 300 turns off certain fan units 200 and runs the remaining fan units 200 at peak efficiency. In an alternative embodiment, the fan units 200 could all run at the same power level (e.g. efficiency and/or flow rate) of operation.

Another advantage of the present invention is that the array controller 300 (which may be a variable frequency drive (VFD)) used for controlling fan speed and thus flow rate and pressure, could be sized for the actual brake horsepower of the fan array fan section in the air-handling system. Since efficiency of the fan array can be optimized over a wide range of flow rates and pressures, the actual operating power consumed by the fan array is substantially less than the actual operating power consumed by the comparable prior art air-handling systems and the array controller's power could be reduced accordingly. The array controller 300 could be sized to the actual power consumption of the fan array where as the controller (which may have been a variable frequency drive) in a traditional design would be sized to the maximum nameplate rating of the motor per Electrical Code requirements. An example of a prior art fan design supplying 50,000 cubic feet per minute of air at 2.5 inches pressure, would require a 50 horsepower motor and 50 horsepower controller. The new invention will preferably use an array of fourteen 2 horsepower motors and a 30 horsepower array controller 300.

This invention solves many of the problems of the prior art air-handling systems including, but not limited to real estate, reduced production costs, reduced operating expenses, increased efficiency, improved air flow uniformity, redundancy, sound attenuation advantages, and reduced vibration.

Controllability

As mentioned, preferably each of the fan units 200 in the fan array fan section in the air-handling system is controlled by an array controller 300 (FIGS. 13 and 14) that may be programmed to operate the fan units 200 at peak efficiency. In this peak efficiency embodiment, rather than running all of the fan units 200 at a reduced efficiency, the array controller 300 is able to turn off certain fan units 200 and run the remaining fan units 200 at peak efficiency. Preferably,

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the array controller 300 is able to control fan units 200 individually, in predetermined groupings, and/or as a group as a whole.

For example, in the 5x5 fan array such as that shown in FIGS. 5, 13, and 14, a person desiring to control the array may select desired air volume, a level of air flow, a pattern of air flow, and/or how many fan units 200 to operate. Turning first to air volume, each fan unit 200 in a 5x5 array contributes 4% of the total air. In variable air volume systems, which is what most structures have, only the number of fan units 200 required to meet the demand would operate. A control system (that may include the array controller 300) would be used to take fan units 200 on line (an "ON" fan unit 200) and off line (an "OFF" fan unit 200) individually. This ability to turn fan units 200 on and off could effectively eliminate the need for a variable frequency drive. Similarly, each fan unit 200 in a 5x5 array uses 4% of the total power and produces 4% of the level of air flow. Using a control system to take fan units 200 on line and off line allows a user to control power usage and/or air flow. The pattern of air flow can also be controlled if that would be desirable. For example, depending on the system it is possible to create a pattern of air flow only around the edges of a cabinet or air only at the top. Finally, individual fan units 200 may be taken on line and off line. This controllability may be advantageous if one or more fan units 200 are not working properly, need to be maintained (e.g. needs general service), and/or need to be replaced. The problematic individual fan units 200 may be taken off line while the remainder of the system remains fully functional. Once the individual fan units 200 are ready for use, they may be brought back on line.

A further advantage to taking fan units 200 on and off line occurs when building or structure control systems require low volumes of air at relatively high pressures. In this case, the fan units 200 could be modulated to produce a stable operating point and eliminate the surge effects that sometimes plague structure owners and maintenance staff. The surge effect is where the system pressure is too high for the fan speed at a given volume and the fan unit 200 has a tendency to go into stall.

Examples of controllability are shown in FIGS. 13 and 14. In the fan array fan section in the air-handling system shown in FIG. 13, the array controller 300 alternates "ON" fan units 200 and "OFF" fan units 200 in a first exemplary pattern as shown so that the entire system is set to operate at 52% of the maximum rated air flow but only consumes 32% of full rated power. These numbers are based on exemplary typical fan operations in a structure. FIG. 14 shows the fan array fan section in the air-handling system set to operate at 32% of the maximum rated air flow but only consumes 17% of full rated power. These numbers are based on exemplary typical fan operations in a structure. In this embodiment, the array controller 300 creates a second exemplary pattern of "OFF" fan units 200 and "ON" fan units 200 as shown.

Real Estate

The fan array fan section in the air-handling section 220 of the present invention preferably uses (60% to 80%) less real estate than prior art discharge plenums 120 (with the hundred series number being prior art as shown in FIG. 1 and the two hundred series number being the present invention as shown in FIG. 3) in air-handling systems. Comparing the prior art (FIG. 1) and the present invention (FIG. 3) shows a graphical representation of this shortening of the airway path 120, 220. There are many reasons that using multiple smaller fan units 200 can reduce the length of the

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airway path 120, 220. For example, reducing the size of the fan unit 100, 200 and motor 108, 208 reduces the length of the discharge plenum 110, 210. Similarly, reducing the size of the inlet cone 104, 204 reduces the length of the inlet plenum 112, 212. The length of the discharge plenum 110, 210 can also be reduced because air from the fan array fan section in the air-handling system of the present invention is substantially uniform whereas the prior art air-handling system has points of higher air velocity and needs time and space to mix so that the flow is uniform by the time it exits the air-handling compartment 102, 202. (This can also be described as the higher static efficiency in that the present invention eliminates the need for settling means downstream from the discharge of a prior art fan system because there is little or no need to transition from high velocity to low velocity.) The fan array fan section in the air-handling system takes in air from the inlet plenum 212 more evenly and efficiently than the prior art air-handling system so that the length of the inlet plenum 112, 212 may be reduced.

For purposes of comparison, the first exemplary structure set forth in the Background of the Invention (a structure requiring 50,000 cubic feet per minute of air flow at a pressure of six (6) inches water gage) will be used. Using the first exemplary structure, an exemplary embodiment of the present invention could be served by a nominal discharge plenum 210 of 89 inches high by 160 inches wide and 30 to 36 inches long (as compared to 106 to 112 inches long in the prior art embodiments). The discharge plenum 210 would include a 3x4 fan array fan section in the air-handling system such as the one shown in FIG. 6) having 12 fan units 200. The space required for each exemplary fan unit 200 would be a rectangular cube of approximately 24 to 30 inches on a side depending on the array configuration. The airway path 220 is 42 to 48 inches (as compared to 88 to 139 inches in the prior art embodiments).

For purposes of comparison, the second exemplary structure set forth in the Background of the Invention (a structure requiring 26,000 cubic feet per minute of air flow at a pressure of two (2) inches water gage) will be used. Using the second exemplary structure, an exemplary embodiment of the present invention could be served by a nominal discharge plenum 210 of 84 inches high by 84 inches wide, and 30 to 36 inches long (as compared to 94 to 100 inches long in the prior art embodiments). The discharge plenum would include a 3x3 fan array fan section in the air-handling system (such as the one shown in FIG. 7) having 9 fan units 200. The space required for each exemplary fan unit 200 would be a rectangular cube of approximately 24 to 30 inches on a side depending on the array configuration. The airway path 220 is 42 to 48 inches (as compared to 71 to 95 inches in the prior art embodiments).

Reduced Production Costs

It is generally more cost effective to build the fan array fan section in the air-handling system of the present invention as compared to the single fan unit 100 used in prior art air-handling systems. Part of this cost savings may be due to the fact that individual fan units 200 of the fan array can be mass-produced. Part of this cost savings may be due to the fact that it is less expensive to manufacture smaller fan units 200. Whereas the prior art single fan units 100 were generally custom built for the particular purpose, the present invention could be implemented on a single type of fan unit 200. In alternative embodiments, there might be several fan units 200 having different sizes and/or powers (both input and output). The different fan units 200 could be used in a single air-handling system or each air-handling system

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would have only one type of fan unit 200. Even when the smaller fan units 200 are custom made, the cost of producing multiple fan units 200 for a particular project is almost always less than the cost of producing a single large prior art fan unit 100 for the same project. This may be because of the difficulties of producing the larger components and/or the cost of obtaining the larger components necessary for the single large prior art fan unit 100. This cost savings also extends to the cost of producing a smaller air-handling compartment 202.

In one preferred embodiment of the invention, the fan units 200 are modular such that the system is "plug and play." Such modular units may be implemented by including structure for interlocking on the exterior of the fan units 200 themselves. Alternatively, such modular units may be implemented by using separate structure for interlocking the fan units 200. In still another alternative embodiment, such modular units may be implemented by using a grid system into which the fan units 200 may be placed.

Reduced Operating Expenses

The fan array fan section in the air-handling system of the present invention preferably are less expensive to operate than prior art air-handling systems because of greater flexibility of control and fine tuning to the operating requirements of the structure. Also, by using smaller higher speed fan units 200 that require less low frequency noise control and less static resistance to flow.

Increased Efficiency

The fan array fan section in the air-handling system of the present invention preferably is more efficient than prior art air-handling systems because each small fan unit 200 can run at peak efficiency. The system could turn individual fan units 200 on and off to prevent inefficient use of particular fan units 200. It should be noted that an array controller 300 could be used to control the fan units 200. As set forth above, the array controller 300 turns off certain fan units 200 and runs the remaining fan units 200 at peak efficiency.

Redundancy

Multiple fan units 200 add to the redundancy of the system. If a single fan unit 200 breaks down, there will still be cooling. The array controller 300 may take disabled fan units 200 into consideration such that there is no noticeable depreciation in cooling or air flow rate. This feature may also be useful during maintenance as the array controller 300 may turn off fan units 200 that are to be maintained offline with no noticeable depreciation in cooling or air flow rate.

Sound Attenuation Advantages

The high frequency sound of the small fan units 200 is easier to attenuate than the low frequency sound of the large fan unit. Because the fan wall has less low frequency sound energy, shorter less costly sound traps are needed to attenuate the higher frequency sound produced by the plurality of small fan units 200 than the low frequency sound produced by the single large fan unit 100. The plurality of fan units 200 will each operate in a manner such that acoustic waves from each unit will interact to cancel sound at certain frequencies thus creating a quieter operating unit than prior art systems.

Reduced Vibration

The multiple fan units 200 of the present invention have smaller wheels with lower mass and create less force due to residual unbalance thus causing less vibration than the large fan unit. The overall vibration of multiple fan units 200 will transmit less energy to a structure since individual fans will

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tend to cancel each other due to slight differences in phase. Each fan unit 200 of the multiple fan units 200 manage a smaller percentage of the total air handling requirement and thus produce less turbulence in the air stream and substantially less vibration.

Alternative Embodiments

As mentioned, in one preferred embodiment of the invention, the fan units 200 are modular such that the system is "plug and play." Such modular units may be implemented by including structure for interlocking on the exterior of the fan units 200 themselves. Alternatively, such modular units may be implemented by using separate structure for interlocking the fan units 200. In still another alternative embodiment, such modular units may be implemented by using a grid system into which the fan units 200 may be placed.

FIG. 16 shows an embodiment using an exemplary grid system 230 into which the fan units 200 may be placed. In this embodiment the grid may be positioned and/or built within the air-handling compartment 202. The fan units 200 may then be positioned into the grid openings. One advantage of this configuration is that individual fan units 200 may be easily removed, maintained, and/or replaced. This embodiment uses an exemplary unique motor mount 232 that supports the motor 208 without interfering with air flow therearound. As shown, this exemplary motor mount 232 has a plurality of arms that mount around the fan inlet cone 204. It should be noted that the dimensions of the grid are meant to be exemplary. The grid may be constructed taking into consideration that the fan units 200 in the present invention may be spaced with as little as 20% of a fan wheel diameter between the fan units 200.

FIG. 17 shows an embodiment using either a grid system or modular units 240 using separate structure (not shown) for interlocking the fan units 200. In this exemplary embodiment, each of the fan units 200 are mounted on a more traditional motor mount 242 within its own fan unit chamber 244. In one preferred embodiment, the fan unit 200 and motor mount 242 are preferably suspended within their own fan unit chamber 244 such that there is an air relief passage 246 therebelow. This air relieve passage 246 tends to improve air flow around the fan units 200.

The fan unit chambers 244 shown in FIG. 17 may include one or more interior surface made from or lined with an acoustically absorptive material or "insulation surface" 248. Going against conventional industry wisdom that surfaces cannot be placed in close proximity with the fan units 200, the present invention places one or more insulation surfaces 248 at least partially around each fan unit 200 without disrupting air flow. The insulation surfaces 248 may include one or more of the sides, top, bottom, front, or back. Exemplary types of insulation include, but are not limited to traditional insulation board (such as that made from inorganic glass fibers (fiberglass) alone or with a factory-applied foil-serim-kraft (FSK) facing or a factory-applied all service jacket (ASJ)) or alternative insulation such as open cell foam such as that disclosed in U.S. patent application Ser. No. 10/606,435, which is assigned to the assignee of the present invention, and which the disclosure of which is hereby incorporated by reference herein. Together, the insulation surfaces 248 on the fan unit chambers 244 tend to function as a coplanar silencer. Some of the benefits of using the coplanar silencer include (1) no added airway length for splitters, (2) no pressure drop, and/or (3) relatively low cost. The acoustic advantages of this and other embodiments make the present invention ideal for use in concert halls,

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lecture halls, performing arts centers, libraries, hospitals, and other applications that are acoustically sensitive.

Although FIG. 17 shows the discharge plenum 210 positioned within the fan unit chambers 244, alternative embodiments of fan unit chambers 244 could enclose the inlet plenum 212, or at least partially enclose both the inlet plenum 212 and the discharge plenum 210. Still other alternative embodiments of fan unit chambers 244 may have grid or wire surfaces (that increase the safety of the present invention) or be open (that would reduce costs).

FIG. 18 shows an array of dampeners 250 that may be positioned either in front of or behind the fan units 200 to at least partially prevent back drafts. In the shown exemplary embodiment, the dampeners 250 include a plurality of plates, each plate positioned on its own pivot. In the shown exemplary embodiment, the plurality of plates slightly overlap each other. The shown embodiment is constructed such that when air is flowing through the fan units 200, the plates are in the open position and when the air stops, gravity pulls the plates into the closed position. Preferably, each of the dampeners 250 operates independently such that if some of the fan units 200 are ON and some of the fan units 200 are OFF, the dampeners 250 can open or close accordingly. Although shown as a simple mechanical embodiment, alternative embodiments could include structure that is controlled electronically and/or remotely from the dampeners 250.

It should be noted that FIG. 4 shows a 4x6 fan array fan section in the air-handling system having twenty-four fan units 200, FIG. 5 shows a 5x5 fan array fan section in the air-handling system having twenty-five fan units 200, FIG. 6 shows a 3x4 fan array fan section in the air-handling system having twelve fan units 200, FIG. 7 shows a 3x3 fan array fan section in the air-handling system having nine fan units 200, and FIG. 8 shows a 3x1 fan array fan section in the air-handling system having three fan units 200. It should be noted that the array may be of any size or dimension of more than two fan units 200. It should be noted that although the fan units 200 may be arranged in a single plane (as shown in FIG. 3), an alternative array configuration could contain a plurality of fan units 200 that are arranged in a staggered configuration (as shown in FIG. 15) in multiple planes. It should be noted that cooling coils (not shown) could be added to the system either upstream or downstream of the fan units 200. It should be noted that, although shown upstream from the fan units 200, the filter bank 122, 222 could be downstream.

It should be noted that an alternative embodiment would use a horizontally arranged fan array. In other words, the embodiments shown in FIGS. 3-15 could be used horizontally or vertically or in any direction perpendicular to the direction of air flow. For example, if a vertical portion of air duct is functioning as the air-handling compartment 202, the fan array may be arranged horizontally. This embodiment would be particularly practical in an air handling compartment for a return air shaft.

It should be noted that the fan section 214 may be any portion of the airway path 220 in which the fan units 200 are positioned. For example, the fan units 200 may be situated in the discharge plenum 210 (as shown), the inlet plenum 212, or partially within the inlet plenum 212 and partially within the discharge plenum 210. It should also be noted that the air-handling compartment 202 may be a section of air duct.

The terms and expressions that have been employed in the foregoing specification are used as terms of description and not of limitation, and are not intended to exclude equivalents

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of the features shown and described or portions of them. The scope of the invention is defined and limited only by the claims that follow.

What is claimed is:

1. A fan array fan section in an air-handling system comprising:
 - (a) an air-handling compartment;
 - (b) a plurality of fan units;
 - (c) said plurality of fan units arranged in a fan array;
 - (d) said fan array positioned within said air-handling compartment;
 - (e) said air-handling compartment associated with a structure such that said air-handling system conditions the air of said structure; and
 - (f) a control system for operating said plurality of fan units at substantially peak efficiency by strategically turning on and off selective ones of said plurality of fan units.
2. The fan array fan section in an air-handling system of claim 1, wherein said control system comprises a programmable array controller.
3. The fan array fan section in an air-handling system of claim 2, wherein each fan unit has a peak efficiency operating range outside of which it operates at a reduced efficiency, wherein said array controller is programmed to operate said plurality of fan units at substantially peak efficiency by strategically turning off at least one fan unit operating at reduced efficiency and running the remaining fan units within said peak efficiency operating range.
4. The fan array fan section in an air-handling system of claim 2, where said array controller is programmed to operate said plurality of fan units at peak efficiency for a performance level based on a criterion selected from the following group of criteria:
 - (a) air volume;
 - (b) level of air flow;
 - (c) pattern of air flow; and
 - (d) number of fan units to operate.
5. The fan array fan section in an air-handling system of claim 2, wherein said array controller is programmed to operate said plurality of fan units to produce a stable operating point and eliminate the surge effects.
6. The fan array fan section in an air-handling system of claim 1, wherein said plurality of fan units are plenum fans.
7. The fan array fan section in an air-handling system of claim 1, wherein said air-handling compartment has an airway path, said airway path being less than 72 inches.
8. The fan array fan section in an air-handling system of claim 1, wherein said plurality of fan units are arranged in a fan array configuration selected from the group consisting of:
 - (a) a true array configuration;
 - (b) a spaced pattern array configuration;
 - (c) a checker board array configuration;
 - (d) rows slightly offset array configuration;
 - (e) columns slightly offset array configuration; and
 - (f) a staggered array configuration.
9. The fan array fan section in an air-handling system of claim 1, wherein each of said plurality of fan units is positioned within a fan unit chamber.
10. The fan array fan section in an air-handling system of claim 1, wherein each of said plurality of fan units is suspended within a respective said fan unit chamber such that there is an air relief passage therebelow.
11. The fan array fan section in an air-handling system of claim 1, wherein each of said plurality of fan units is

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positioned within a fan unit chamber having at least one acoustically absorptive insulation surface.

12. The fan array fan section in an air-handling system of claim 1, wherein each of said plurality of fan units is mounted in a grid system.

13. The fan array fan section in an air-handling system of claim 1, wherein each of said plurality of fan units has a fan wheel diameter, wherein spacing between said plurality of fan units is less than 60% of said fan wheel diameter.

14. The fan array fan section in an air-handling system of claim 1, further comprising an array of backdraft dampeners, each backdraft dampener in line with a respective fan unit.

15. A fan array fan section in an air-handling system comprising:

- (a) an air-handling compartment;
- (b) a plurality of fan units;
- (c) said plurality of fan units arranged in a fan array;
- (d) said fan array positioned within said air-handling compartment;
- (e) said air-handling compartment association with a structure such that the said air-handling system conditions the air of said structure; and
- (f) a control system for controlling said plurality of fan units, said control system allowing control of the speed of the fan units in said plurality of fan units such that they run at substantially peak efficiency.

16. The fan array section in an air-handling system of claim 15 wherein said control system comprises a programmable array controller.

17. The fan array fan section in an air-handling system of claim 16, wherein each fan unit has a peak efficiency

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operating range outside of which it operates at a reduced efficiency, wherein said array controller is programmed to operate said plurality of fan units at substantially peak efficiency by strategically turning off at least one fan unit operating at reduced efficiency and running the remaining fan units within said peak efficiency operating range.

18. The fan array fan section in an air-handling system of claim 16, wherein said array controller is programmed to operate said plurality of fan units at peak efficiency for a performance level based on a criterion selected from the following group of criteria:

- (a) air volume;
- (b) level of air flow;
- (c) pattern of air flow; and
- (d) number of fan units to operate.

19. A fan array fan section in an air-handling system comprising:

- (a) an air-handling compartment;
- (b) a plurality of independently controllable fan units;
- (c) said plurality of fan units arranged in a fan array;
- (d) said fan array positioned within said air-handling compartment;
- (e) said air-handling compartment associated with a structure such that the said air-handling system conditions the air of said structure; and
- (f) a control system for controlling the speed of the fan units in said plurality of fan units such that they run at substantially peak efficiency.

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**FAN ARRAY FAN SECTION IN AIR-HANDLING SYSTEMS
ABSTRACT OF THE DISCLOSURE**

5 A fan array fan section in an air-handling system includes a plurality
of fan units arranged in a fan array and positioned within an air-handling
compartment. One preferred embodiment may include an array controller
programmed to operate the plurality of fan units at peak efficiency. The plurality
of fan units may be arranged in a true array configuration, a spaced pattern array
10 configuration, a checker board array configuration, rows slightly offset array
configuration, columns slightly offset array configuration, or a staggered array
configuration.

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FAN ARRAY FAN SECTION IN AIR-HANDLING SYSTEMS

The present application is a continuation application of U.S. Patent Application Serial Number 10/806,775, filed March 22, 2004, and entitled FAN ARRAY
5 FAN SECTION IN AIR-HANDLING SYSTEMS. U.S. Patent Application Serial Number 10/806,775 is a nonprovisional application claiming the benefit under 35 USC Section 119(e) of U.S. Provisional Patent Application Serial Number 60/554,702, filed March 20, 2004, and entitled FAN ARRAY FAN SECTION IN AIR-HANDLING SYSTEMS. U.S.
10 Patent Application Serial Number 10/806,775 is a nonprovisional application claiming the benefit under 35 USC Section 119(e) of U.S. Provisional Patent Application Serial Number 60/456,413, filed March 20, 2003, and entitled FAN ARRAY FAN SECTION IN AIR-HANDLING SYSTEMS. U.S. Patent Application Serial Number 10/806,775 is a continuation-in-part application of PCT Patent Application Serial Number PCT/US2004/008578, filed March 19, 2004, and entitled FAN ARRAY FAN SECTION
15 IN AIR-HANDLING SYSTEMS. The present application is based on and claims priority from these applications, the disclosures of which are hereby expressly incorporated herein by reference.

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BACKGROUND OF INVENTION

The present invention is directed to a fan array fan section utilized in an air-handling system.

Air-handling systems (also referred to as an air handler) have traditionally been used to condition buildings or rooms (hereinafter referred to as "structures"). An air-handling system is defined as a system that includes components designed to work together in order to condition air as part of the primary system for ventilation of structures. The air-handling system may contain components such as cooling coils, heating coils, filters, humidifiers, fans, sound attenuators, controls, and other devices functioning to meet the needs of the structures. The air-handling system may be manufactured in a factory and brought to the structure to be installed or it may be built on site using the necessary devices to meet the functioning needs of the structure. The air-handling compartment 102 of the air-handling system includes the inlet plenum 112 prior to the fan inlet cone 104 and the discharge plenum 110. Within the air-handling compartment 102 is situated the fan unit 100 (shown in FIGS. 1 and 2 as an inlet cone 104, a fan 106, and a motor 108), fan frame, and any appurtenance associated with the function of the fan (e.g. dampers, controls, settling means, and associated cabinetry). Within the fan 106 is a fan wheel (not shown) having at least one blade. The fan wheel has a fan wheel diameter that is measured from one side of the outer periphery of the fan wheel to the opposite side of the outer periphery of the fan wheel. The dimensions of the handling compartment 102 such as height, width, and airway length are determined by consulting fan manufacturers data for the type of fan selected.

FIG. 1 shows an exemplary prior art air-handling system having a single fan unit 100 housed in an air-handling compartment 102. For exemplary purposes, the fan unit 100 is shown having an inlet cone 104, a fan 106, and a motor 108. Larger structures, structures requiring greater air volume, or structures requiring higher or lower temperatures have generally needed a larger fan unit 100 and a generally correspondingly larger air-handling compartment 102.

As shown in FIG. 1, an air-handling compartment 102 is substantially divided into a discharge plenum 110 and an inlet plenum 112. The combined discharge

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plenum 110 and the inlet plenum 112 can be referred to as the airway path 120. The fan unit 100 may be situated in the discharge plenum 110 as shown), the inlet plenum 112, or partially within the inlet plenum 112 and partially within the discharge plenum 110. The portion of the airway path 120 in which the fan unit 100 is positioned may be generically referred to as the "fan section" (indicated by reference numeral 114). The size of the inlet cone 104, the size of the fan 106, the size the motor 108, and the size of the fan frame (not shown) at least partially determine the length of the airway path 120. Filter banks 122 and/or cooling coils (not shown) may be added to the system either upstream or downstream of the fan units 100.

For example, a first exemplary structure requiring 50,000 cubic feet per minute of air flow at six (6) inches water gage pressure would generally require a prior art air-handling compartment 102 large enough to house a 55 inch impeller, a 100 horsepower motor, and supporting framework. The prior art air-handling compartment 102, in turn would be approximately 92 inches high by 114 to 147 inches wide and 106 to 112 inches long. The minimum length of the air-handling compartment 102 and/or airway path 120 would be dictated by published manufacturers data for a given fan type, motor size, and application. Prior art cabinet sizing guides show exemplary rules for configuring an air-handling compartment 102. These rules are based on optimization, regulations, and experimentation.

For example, a second exemplary structure includes a recirculation air handler used in semiconductor and pharmaceutical clean rooms requiring 26,000 cubic feet per minute at two (2) inches water gage pressure. This structure would generally require a prior art air-handling system with a air-handling compartment 102 large enough to house a 44 inch impeller, a 25 horsepower motor, and supporting framework. The prior art air-handling compartment 102, in turn would be approximately 78 inches high by 99 inches wide and 94 to 100 inches long. The minimum length of the air-handling compartment 102 and/or airway path 120 would be dictated by published manufacturers data for a given fan type, motor size and application. Prior art cabinet sizing guides show exemplary rules for configuring an air-handling compartment 102. These rules are based on optimization, regulations, and experimentation.

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These prior art air-handling systems have many problems including the following exemplary problems:

- 5 • Because real estate (e.g. structure space) is extremely expensive, the larger size of the air-handling compartment 102 is extremely undesirable.
- The single fan units 100 are expensive to produce and are generally custom produced for each job.
- Single fan units 100 are expensive to operate.
- 10 • Single fan units 100 are inefficient in that they only have optimal or peak efficiency over a small portion of their operating range.
- If a single fan unit 100 breaks down, there is no air conditioning at all.
- The low frequency sound of the large fan unit 100 is hard to attenuate.
- 15 • The high mass and turbulence of the large fan unit 100 can cause undesirable vibration.

Height restrictions have necessitated the use of air-handling systems built with two fan units 100 arranged horizontally adjacent to each other. It should be noted, however, that a good engineering practice is to design air handler cabinets and
20 discharge plenums 110 to be symmetrical to facilitate more uniform air flow across the width and height of the cabinet. Twin fan units 100 have been utilized where there is a height restriction and the unit is designed with a high aspect ratio to accommodate the desired flow rate. As shown in the Greenheck "Installation Operating and Maintenance Manual," if side-by-side installation was contemplated, there were specific instructions
25 to arrange the fans such that there was at least one fan wheel diameter spacing between the fan wheels and at least one-half a fan wheel diameter between the fan and the walls or ceilings. The Greenheck reference even specifically states that arrangements "with less spacing will experience performance losses." Normally, the air-handling system and air-handling compartment 102 are designed for a uniform velocity
30 gradient of 500 feet per minute velocity in the direction of air flow. The two fan unit 100

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air-handling systems, however, still substantially suffered from the problems of the single unit embodiments. There was no recognition of advantages by increasing the number of fan units 100 from one to two. Further, the two fan unit 100 section exhibits a non-uniform velocity gradient in the region following the fan unit 100 that creates uneven air flow across filters, coils, and sound attenuators.

It should be noted that electrical devices have taken advantage of multiple fan cooling systems. For example, U.S. Patent No. 6,414,845 to Bonet uses a multiple-fan modular cooling component for installation in multiple component-bay electronic devices. Although some of the advantages realized in the Bonet system would be realized in the present system, there are significant differences. For example, the Bonet system is designed to facilitate electronic component cooling by directing the output from each fan to a specific device or area. The Bonet system would not work to direct air flow to all devices in the direction of general air flow. Other patents such as U.S. Patent No. 4,767,262 to Simon and U.S. Patent No. 6,388,880 to El-Ghobashy et al. teach fan arrays for use with electronics.

Even in the computer and machine industries, however, operating fans in parallel is taught against as not providing the desired results except in low system resistance situations where fans operate in near free delivery. For example, Sunon Group has a web page in which they show two axial fans operating in parallel, but specifically state that if "the parallel fans are applied to the higher system resistance that [an] enclosure has, . . . less increase in flow results with parallel fan operation." Similar examples of teaching against using fans in parallel are found in an article accessible from HighBeam Research's library (<http://stati.highbeam.com>) and an article by Ian McLeod accessible at (<http://www.papstplc.com>).

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BRIEF SUMMARY OF THE INVENTION

The present invention is directed to a fan array fan section in an air-handling system that includes a plurality of fan units arranged in a fan array and positioned within an air-handling compartment. One preferred embodiment may include an array controller programmed to operate the plurality of fan units at peak efficiency. The plurality of fan units may be arranged in a true array configuration, a spaced pattern array configuration, a checker board array configuration, rows slightly offset array configuration, columns slightly offset array configuration, or a staggered array configuration.

10 The foregoing and other objectives, features, and advantages of the invention will be more readily understood upon consideration of the following detailed description of the invention, taken in conjunction with the accompanying drawings.

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BRIEF DESCRIPTION OF THE SEVERAL VIEWS OF THE DRAWINGS

FIG. 1 is a side view of an exemplary prior art air-handling system having a single large fan unit within an air-handling compartment.

FIG. 2 is a perspective view of an exemplary prior art large fan unit.

5 FIG. 3 is a side view of an exemplary fan array fan section in an air-handling system of the present invention having a plurality of small fan units within an air-handling compartment.

10 FIG. 4 is a plan or elevation view of a 4x6 exemplary fan array fan section in an air-handling system of the present invention having a plurality of small fan units within an air-handling compartment.

FIG. 5 is a plan or elevation view of a 5x5 exemplary fan array fan section in an air-handling system of the present invention having a plurality of small fan units within an air-handling compartment.

15 FIG. 6 is a plan or elevation view of a 3x4 exemplary fan array fan section in an air-handling system of the present invention having a plurality of small fan units within an air-handling compartment.

FIG. 7 is a plan or elevation view of a 3x3 exemplary fan array fan section in an air-handling system of the present invention having a plurality of small fan units within an air-handling compartment.

20 FIG. 8 is a plan or elevation view of a 3x1 exemplary fan array fan section in an air-handling system of the present invention having a plurality of small fan units within an air-handling compartment.

25 FIG. 9 is a plan or elevation view of an alternative exemplary fan array fan section in an air-handling system of the present invention in which a plurality of small fan units are arranged in a spaced pattern array within an air-handling compartment.

FIG. 10 is a plan or elevation view of an alternative exemplary fan array fan section in an air-handling system of the present invention in which a plurality of small fan units are arranged in a checker board array within an air-handling compartment.

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FIG. 11 is a plan or elevation view of an alternative exemplary fan array fan section in an air-handling system of the present invention in which a plurality of small fan units are arranged in rows slightly offset array within an air-handling compartment.

5 FIG. 12 is a plan or elevation view of an alternative exemplary fan array fan section in an air-handling system of the present invention in which a plurality of small fan units are arranged in columns slightly offset array within an air-handling compartment.

10 FIG. 13 is a plan or elevation view of a 5x5 exemplary fan array fan section in an air-handling system of the present invention running at 52% capacity by turning a portion of the fans on and a portion of the fans off.

FIG. 14 is a plan or elevation view of a 5x5 exemplary fan array fan section in an air-handling system of the present invention running at 32% capacity by turning a portion of the fans on and a portion of the fans off.

15 FIG. 15 is a side view of an alternative exemplary fan array fan section in an air-handling system of the present invention having a plurality of staggered small fan units within an air-handling compartment.

FIG. 16 is a perspective view of an exemplary fan array using a grid system into which fan units are mounted.

20 FIG. 17 is a perspective view of an exemplary fan array using a grid system or modular units each of which includes a fan units mounted within its own fan unit chamber.

FIG. 18 is a perspective view of an exemplary array of dampeners that may be positioned either in front of or behind the fan units.

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DETAILED DESCRIPTION OF THE INVENTION

The present invention is directed to a fan array fan section in an air-handling system. As shown in FIGS. 3-12, the fan array fan section in the air-handling system uses a plurality of individual single fan units 200. In one preferred embodiment, the fan units 200 are arranged in a true array (FIGS. 4-8), but alternative embodiments may include, for example, alternative arrangements such as in a spaced pattern (FIG. 9), a checker board (FIG. 10), rows slightly offset (FIG. 11), or columns slightly offset (FIG. 12). As the present invention could be implemented with true arrays and/or alternative arrays, the term "array" is meant to be comprehensive.

The fan units 200 in the fan array of the present invention may be spaced as little as 20% of a fan wheel diameter. Optimum operating conditions for a closely arranged array may be found at distances as low as 30% to 60% of a fan wheel diameter. By closely spacing the fan units 200, more air may be moved in a smaller space. For example, if the fan wheels of the fan units 200 have a 20 inch fan wheel diameter, only a 4 inch space (20%) is needed between the outer periphery of one fan wheel and the outer periphery of the adjacent fan wheel (or a 2 inch space between the outer periphery of a fan wheel and an the adjacent wall or ceiling).

By using smaller fan units 200 it is possible to support the fan units 200 with less intrusive structure (fan frame). This can be compared to the large fan frame that supports prior art fan units 100 and functions as a base. This large fan frame must be large and sturdy enough to support the entire weight of the prior art fan units 100. Because of their size and position, the known fan frames cause interference with air flow. In the preferred embodiment, therefore, the fan units 200 of the fan array may be supported by a frame that supports the motors 108 with a minimum restriction to air flow.

As mentioned in the Background, others have tried using side-by-side installation of two fan units 100 arranged horizontally adjacent to each other within an air-handling system. As is also mentioned in the Background, fan arrays have been used in electronic and computer assemblies. However, in the air-handling system industry, it has always been held that there must be significant spacing between the

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horizontally arranged fan wheels and that arrangements with less spacing will experience performance losses. A single large fan moves all the air in a cabinet. Using two of the same or slightly smaller fans caused the air produced by one fan to interfere with the air produced by the other fan. To alleviate the interference problem, the fans

5 had to be spaced within certain guidelines – generally providing a clear space between the fans of a distance of at least one wheel diameter (and a half a wheel diameter to an adjacent wall). Applying this logic, it would not have made sense to add more fans. And even if additional fans had been added, the spacing would have continued to be at least one wheel diameter between fans. Further, in the air-handling system industry,

10 vertically stacking fan units would have been unthinkable because the means for securing the fan units would not have been conducive to such stacking (they are designed to be positioned on the floor only).

It should be noted that the plenum fan is the preferred fan unit 200 of the present invention. In particular, the APF-121, APF-141, APF-161, and APF-181 plenum

15 fans (particularly the fan wheel and the fan cone) produced by Twin City Fan Companies, Ltd. of Minneapolis, Minnesota, U.S. has been found to work well. The reason that plenum fans work best is that they do not produce points of high velocity such as those produced by axial fans and housed centrifugal fans and large plenum fans. Alternative embodiments use known fan units or fan units yet to be developed

20 that will not produce high velocity gradients in the direction of air flow. Still other embodiments, albeit less efficient, use fan units such as axial fans and/or centrifugal housed fans that have points of high velocity in the direction of air flow.

In the preferred embodiment, each of the fan units 200 in the fan array fan section in the air-handling system is controlled by an array controller 300 (FIGS. 13 and

25 14). In one preferred embodiment, the array controller 300 may be programmed to operate the fan units 200 at peak efficiency. In this peak efficiency embodiment, rather than running all of the fan units 200 at a reduced efficiency, the array controller 300 turns off certain fan units 200 and runs the remaining fan units 200 at peak efficiency. In an alternative embodiment, the fan units 200 could all run at the same power level

30 (e.g. efficiency and/or flow rate) of operation.

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Another advantage of the present invention is that the array controller 300 (which may be a variable frequency drive (VFD)) used for controlling fan speed and thus flow rate and pressure, could be sized for the actual brake horsepower of the fan array fan section in the air-handling system. Since efficiency of the fan wall array can be optimized over a wide range of flow rates and pressures, the actual operating power consumed by the fan array is substantially less than the actual operating power consumed by the comparable prior art air-handling systems and the array controller's power could be reduced accordingly. The array controller 300 could be sized to the actual power consumption of the fan array where as the controller (which may have been a variable frequency drive) in a traditional design would be sized to the maximum nameplate rating of the motor per Electrical Code requirements. An example of a prior art fan design supplying 50,000 cubic feet per minute of air at 2.5 inches pressure, would require a 50 horsepower motor and 50 horsepower controller. The new invention will preferably use an array of fourteen 2 horsepower motors and a 30 horsepower array controller 300.

This invention solves many of the problems of the prior art air-handling systems including, but not limited to real estate, reduced production costs, reduced operating expenses, increased efficiency, improved air flow uniformity, redundancy, sound attenuation advantages, and reduced vibration.

20

Controllability

As mentioned, preferably each of the fan units 200 in the fan array fan section in the air-handling system is controlled by an array controller 300 (FIGS. 13 and 14) that may be programmed to operate the fan units 200 at peak efficiency. In this peak efficiency embodiment, rather than running all of the fan units 200 at a reduced efficiency, the array controller 300 is able to turn off certain fan units 200 and run the remaining fan units 200 at peak efficiency. Preferably, the array controller 300 is able to control fan units 200 individually, in predetermined groupings, and/or as a group as a whole.

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For example, in the 5x5 fan array such as that shown in FIGS. 5, 13, and 14, a person-desiring to control the array may select desired air volume, a level of air flow, a pattern of air flow, and/or how many fan units 200 to operate. Turning first to air volume, each fan unit 200 in a 5x5 array contributes 4% of the total air. In variable air volume systems, which is what most structures have, only the number of fan units 200 required to meet the demand would operate. A control system (that may include the array controller 300) would be used to take fan units 200 on line (an "ON" fan unit 200) and off line (an "OFF" fan unit 200) individually. This ability to turn fan units 200 on and off could effectively eliminate the need for a variable frequency drive. Similarly, each fan unit 200 in a 5x5 array uses 4% of the total power and produces 4% of the level of air flow. Using a control system to take fan units 200 on line and off line allows a user to control power usage and/or air flow. The pattern of air flow can also be controlled if that would be desirable. For example, depending on the system it is possible to create a pattern of air flow only around the edges of a cabinet or air only at the top. Finally, individual fan units 200 may be taken on line and off line. This controllability may be advantageous if one or more fan units 200 are not working properly, need to be maintained (e.g. needs general service), and/or need to be replaced. The problematic individual fan units 200 may be taken off line while the remainder of the system remains fully functional. Once the individual fan units 200 are ready for use, they may be brought back on line.

A further advantage to taking fan units 200 on and off line occurs when building or structure control systems require low volumes of air at relatively high pressures. In this case, the fan units 200 could be modulated to produce a stable operating point and eliminate the surge effects that sometimes plague structure owners and maintenance staff. The surge effect is where the system pressure is too high for the fan speed at a given volume and the fan unit 200 has a tendency to go into stall.

Examples of controllability are shown in FIGS. 13 and 14. In the fan array fan section in the air-handling system shown in FIG. 13, the array controller 300 alternates "ON" fan units 200 and "OFF" fan units 200 in a first exemplary pattern as shown so that the entire system is set to operate at 52% of the maximum rated air flow

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but only consumes 32% of full rated power. These numbers are based on exemplary typical fan operations in a structure. FIG. 14 shows the fan array fan section in the air-handling system set to operate at 32% of the maximum rated air flow but only consumes 17% of full rated power. These numbers are based on exemplary typical fan operations in a structure. In this embodiment, the array controller 300 creates a second exemplary pattern of "OFF" fan units 200 and "ON" fan units 200 as shown.

Real Estate

The fan array fan section in the air-handling section 220 of the present invention preferably uses (60% to 80%) less real estate than prior art discharge plenums 120 (with the hundred series number being prior art as shown in FIG. 1 and the two hundred series number being the present invention as shown in FIG. 3) in air-handling systems. Comparing the prior art (FIG. 1) and the present invention (FIG. 3) shows a graphical representation of this shortening of the airway path 120, 220. There are many reasons that using multiple smaller fan units 200 can reduce the length of the airway path 120, 220. For example, reducing the size of the fan unit 100, 200 and motor 108, 208 reduces the length of the discharge plenum 110, 210. Similarly, reducing the size of the inlet cone 104, 204 reduces the length of the inlet plenum 112, 212. The length of the discharge plenum 110, 210 can also be reduced because air from the fan array fan section in the air-handling system of the present invention is substantially uniform whereas the prior art air-handling system has points of higher air velocity and needs time and space to mix so that the flow is uniform by the time it exits the air-handling compartment 102, 202. (This can also be described as the higher static efficiency in that the present invention eliminates the need for settling means downstream from the discharge of a prior art fan system because there is little or no need to transition from high velocity to low velocity.) The fan array fan section in the air-handling system takes in air from the inlet plenum 212 more evenly and efficiently than the prior art air-handling system so that the length of the inlet plenum 112, 212 may be reduced.

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For purposes of comparison, the first exemplary structure set forth in the Background of the Invention (a structure requiring 50,000 cubic feet per minute of air flow at a pressure of six (6) inches water gage) will be used. Using the first exemplary structure, an exemplary embodiment of the present invention could be served by a nominal discharge plenum 210 of 89 inches high by 160 inches wide and 30 to 36 inches long (as compared to 106 to 112 inches long in the prior art embodiments). The discharge plenum 210 would include a 3x4 fan array fan section in the air-handling system such as the one shown in FIG. 6) having 12 fan units 200. The space required for each exemplary fan unit 200 would be a rectangular cube of approximately 24 to 30 inches on a side depending on the array configuration. The airway path 220 is 42 to 48 inches (as compared to 88 to 139 inches in the prior art embodiments).

For purposes of comparison, the second exemplary structure set forth in the Background of the Invention (a structure requiring 26,000 cubic feet per minute of air flow at a pressure of two (2) inches water gage) will be used. Using the second exemplary structure, an exemplary embodiment of the present invention could be served by a nominal discharge plenum 210 of 84 inches high by 84 inches wide, and 30 to 36 inches long (as compared to 94 to 100 inches long in the prior art embodiments). The discharge plenum would include a 3x3 fan array fan section in the air-handling system (such as the one shown in FIG. 7) having 9 fan units 200. The space required for each exemplary fan unit 200 would be a rectangular cube of approximately 24 to 30 inches on a side depending on the array configuration. The airway path 220 is 42 to 48 inches (as compared to 71 to 95 inches in the prior art embodiments).

25 Reduced Production Costs

It is generally more cost effective to build the fan array fan section in the air-handling system of the present invention as compared to the single fan unit 100 used in prior art air-handling systems. Part of this cost savings may be due to the fact that individual fan units 200 of the fan array can be mass-produced. Part of this cost savings may be due to the fact that it is less expensive to manufacture smaller fan units

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200. Whereas the prior art single fan units 100 were generally custom built for the particular purpose, the present invention could be implemented on a single type of fan unit 200. In alternative embodiments, there might be several fan units 200 having different sizes and/or powers (both input and output). The different fan units 200 could be used in a single air-handling system or each air-handling system would have only one type of fan unit 200. Even when the smaller fan units 200 are custom made, the cost of producing multiple fan units 200 for a particular project is almost always less than the cost of producing a single large prior art fan unit 100 for the same project. This may be because of the difficulties of producing the larger components and/or the cost of obtaining the larger components necessary for the single large prior art fan unit 100. This cost savings also extends to the cost of producing a smaller air-handling compartment 202.

In one preferred embodiment of the invention, the fan units 200 are modular such that the system is "plug and play." Such modular units may be implemented by including structure for interlocking on the exterior of the fan units 200 themselves. Alternatively, such modular units may be implemented by using separate structure for interlocking the fan units 200. In still another alternative embodiment, such modular units may be implemented by using a grid system into which the fan units 200 may be placed.

Reduced Operating Expenses

The fan array fan section in the air-handling system of the present invention preferably are less expensive to operate than prior art air-handling systems because of greater flexibility of control and fine tuning to the operating requirements of the structure. Also, by using smaller higher speed fan units 200 that require less low frequency noise control and less static resistance to flow.

Increased Efficiency

The fan array fan section in the air-handling system of the present invention preferably is more efficient than prior art air-handling systems because each

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small fan unit 200 can run at peak efficiency. The system could turn individual fan units 200 on and off to prevent inefficient use of particular fan units 200. It should be noted that an array controller 300 could be used to control the fan units 200. As set forth above, the array controller 300 turns off certain fan units 200 and runs the remaining fan units 200 at peak efficiency.

Redundancy

Multiple fan units 200 add to the redundancy of the system. If a single fan unit 200 breaks down, there will still be cooling. The array controller 300 may take disabled fan units 200 into consideration such that there is no noticeable depreciation in cooling or air flow rate. This feature may also be useful during maintenance as the array controller 300 may turn off fan units 200 that are to be maintained offline with no noticeable depreciation in cooling or air flow rate.

15 Sound Attenuation Advantages

The high frequency sound of the small fan units 200 is easier to attenuate than the low frequency sound of the large fan unit. Because the fan wall has less low frequency sound energy, shorter less costly sound traps are needed to attenuate the higher frequency sound produced by the plurality of small fan units 200 than the low frequency sound produced by the single large fan unit 100. The plurality of fan units 200 will each operate in a manner such that acoustic waves from each unit will interact to cancel sound at certain frequencies thus creating a quieter operating unit than prior art systems.

25 Reduced Vibration

The multiple fan units 200 of the present invention have smaller wheels with lower mass and create less force due to residual unbalance thus causing less vibration than the large fan unit. The overall vibration of multiple fan units 200 will transmit less energy to a structure since individual fans will tend to cancel each other due to slight differences in phase. Each fan unit 200 of the multiple fan units 200

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manage a smaller percentage of the total air handling requirement and thus produce less turbulence in the air stream and substantially less vibration.

Alternative Embodiments

5 As mentioned, in one preferred embodiment of the invention, the fan units 200 are modular such that the system is "plug and play." Such modular units may be implemented by including structure for interlocking on the exterior of the fan units 200 themselves. Alternatively, such modular units may be implemented by using separate structure for interlocking the fan units 200. In still another alternative embodiment, such
10 modular units may be implemented by using a grid system into which the fan units 200 may be placed.

FIG. 16 shows an embodiment using an exemplary grid system 230 into which the fan units 200 may be placed. In this embodiment the grid may be positioned and/or built within the air-handling compartment 202. The fan units 200 may then be
15 positioned into the grid openings. One advantage of this configuration is that individual fan units 200 may be easily removed, maintained, and/or replaced. This embodiment uses an exemplary unique motor mount 232 that supports the motor 208 without interfering with air flow therearound. As shown, this exemplary motor mount 232 has a plurality of arms that mount around the fan inlet cone 204. It should be noted that the
20 dimensions of the grid are meant to be exemplary. The grid may be constructed taking into consideration that the fan units 200 in the present invention may be spaced with as little as 20% of a fan wheel diameter between the fan units 200.

FIG. 17 shows an embodiment using either a grid system or modular units 240 using separate structure (not shown) for interlocking the fan units 200. In this
25 exemplary embodiment, each of the fan units 200 are mounted on a more traditional motor mount 242 within its own fan unit chamber 244. In one preferred embodiment, the fan unit 200 and motor mount 242 are preferably suspended within their own fan unit chamber 244 such that there is an air relief passage 246 therebelow. This air relieve passage 246 tends to improve air flow around the fan units 200.

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The fan unit chambers 244 shown in FIG. 17 may include one or more interior surface made from or lined with an acoustically absorptive material or "insulation surface" 248. Going against conventional industry wisdom that surfaces cannot be placed in close proximity with the fan units 200, the present invention places one or more insulation surfaces 248 at least partially around each fan unit 200 without disrupting air flow. The insulation surfaces 248 may include one or more of the sides, top, bottom, front, or back. Exemplary types of insulation include, but are not limited to traditional insulation board (such as that made from inorganic glass fibers (fiberglass) alone or with a factory-applied foil-scrim-kraft (FSK) facing or a factory-applied all service jacket (ASJ)) or alternative insulation such as open cell foam such as that disclosed in U.S. Patent Application No.10/606,435, which is assigned to the assignee of the present invention, and which the disclosure of which is hereby incorporated by reference herein. Together, the insulation surfaces 248 on the fan unit chambers 244 tend to function as a coplanar silencer. Some of the benefits of using the coplanar silencer include (1) no added airway length for splitters, (2) no pressure drop, and/or (3) relatively low cost. The acoustic advantages of this and other embodiments make the present invention ideal for use in concert halls, lecture halls, performing arts centers, libraries, hospitals, and other applications that are acoustically sensitive.

Although FIG. 17 shows the discharge plenum 210 positioned within the fan unit chambers 244, alternative embodiments of fan unit chambers 244 could enclose the inlet plenum 212, or at least partially enclose both the inlet plenum 212 and the discharge plenum 210. Still other alternative embodiments of fan unit chambers 244 may have grid or wire surfaces (that increase the safety of the present invention) or be open (that would reduce costs).

FIG. 18 shows an array of dampeners 250 that may be positioned either in front of or behind the fan units 200 to at least partially prevent back drafts. In the shown exemplary embodiment, the dampeners 250 include a plurality of plates, each plate positioned on its own pivot. In the shown exemplary embodiment, the plurality of plates slightly overlap each other. The shown embodiment is constructed such that when air is flowing through the fan units 200, the plates are in the open position and when the air

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stops, gravity pulls the plates into the closed position. Preferably, each of the dampeners 250 operates independently such that if some of the fan units 200 are ON and some of the fan units 200 are OFF, the dampeners 250 can open or close accordingly. Although shown as a simple mechanical embodiment, alternative
5 embodiments could include structure that is controlled electronically and/or remotely from the dampeners 250.

It should be noted that FIG. 4 shows a 4x6 fan array fan section in the air-handling system having twenty-four fan units 200, FIG. 5 shows a 5x5 fan array fan section in the air-handling system having twenty-five fan units 200, FIG. 6 shows a 3x4
10 fan array fan section in the air-handling system having twelve fan units 200, FIG. 7 shows a 3x3 fan array fan section in the air-handling system having nine fan units 200, and FIG. 8 shows a 3x1 fan array fan section in the air-handling system having three fan units 200. It should be noted that the array may be of any size or dimension of more than two fan units 200. It should be noted that although the fan units 200 may be
15 arranged in a single plane (as shown in FIG. 3), an alternative array configuration could contain a plurality of fan units 200 that are arranged in a staggered configuration (as shown in FIG. 15) in multiple planes. It should be noted that cooling coils (not shown) could be added to the system either upstream or downstream of the fan units 200. It should be noted that, although shown upstream from the fan units 200, the filter bank
20 122, 222 could be downstream.

It should be noted that an alternative embodiment would use a horizontally arranged fan array. In other words, the embodiments shown in FIGS. 3-15 could be used horizontally or vertically or in any direction perpendicular to the direction of air flow. For example, if a vertical portion of air duct is functioning as the air-handling
25 compartment 202, the fan array may be arranged horizontally. This embodiment would be particularly practical in an air handling compartment for a return air shaft.

It should be noted that the fan section 214 may be any portion of the airway path 220 in which the fan units 200 are positioned. For example, the fan units 200 may be situated in the discharge plenum 210 (as shown), the inlet plenum 212, or
30 partially within the inlet plenum 212 and partially within the discharge plenum 210. It

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should also be noted that the air-handling compartment 202 may be a section of air duct.

The terms and expressions that have been employed in the foregoing specification are used as terms of description and not of limitation, and are not intended
5 to exclude equivalents of the features shown and described or portions of them. The scope of the invention is defined and limited only by the claims that follow.

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WHAT IS CLAIMED IS:

- 1 1. A fan array fan section in an air-handling system comprising:
 - 2 (a) an air-handling compartment;
 - 3 (b) a plurality of fan units;
 - 4 (c) said plurality of fan units arranged in a fan array;
 - 5 (d) said fan array having at least one fan unit arranged vertically on at
 - 6 least one other fan unit;
 - 7 (e) said fan array positioned within said air-handling compartment; and
 - 8 (f) said air-handling compartment positionable within a structure such
 - 9 that said air-handling system conditions the air of said structure.

10

- 1 2. The fan array fan section in an air-handling system of claim 1 further
- 2 comprising an array controller programmed to operate said plurality of fan units at peak
- 3 efficiency by strategically turning on and off selective ones of said plurality of fan units.

4

- 1 3. The fan array fan section in an air-handling system of claim 1, wherein
- 2 said plurality of fan units are plenum fans.

3

- 1 4. The fan array fan section in an air-handling system of claim 1, wherein
- 2 said air-handling compartment has an airway path, said airway path being less than 72
- 3 inches.

4

- 1 5. The fan array fan section in an air-handling system of claim 1, wherein
- 2 said plurality of fan units are arranged in a fan array configuration selected from the
- 3 group consisting of:

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- 4 (a) a true array configuration;
- 5 (b) a spaced pattern array configuration;
- 6 (c) a checker board array configuration;
- 7 (d) rows slightly offset array configuration;
- 8 (e) columns slightly offset array configuration; and
- 9 (f) a staggered array configuration.

10

1 6. The fan array fan section in an air-handling system of claim 1, wherein
2 each of said plurality of fan units is positioned within a fan unit chamber.

3

1 7. The fan array fan section in an air-handling system of claim 1, wherein
2 each of said plurality of fan units is suspended within a respective said fan unit chamber
3 such that there is an air relief passage therebelow.

4

1 8. The fan array fan section in an air-handling system of claim 1, wherein
2 each of said plurality of fan units is positioned within a fan unit chamber having at least
3 one acoustically absorptive insulation surface.

4

1 9. The fan array fan section in an air-handling system of claim 1, wherein
2 each of said plurality of fan units is mounted in a grid system.

3

1 10. The fan array fan section in an air-handling system of claim 1,
2 wherein each of said plurality of fan units has a fan wheel diameter, wherein spacing
3 between said plurality of fan units is less than 60% of said fan wheel diameter.

4

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1 11. The fan array fan section in an air-handling system of claim 1, further
2 comprising an array of backdraft dampeners, each backdraft dampener in line with a
3 respective fan unit.
4

1 12. The fan array fan section in an air-handling system of claim 1, further
2 comprising an array controller, wherein each fan unit has a peak efficiency operating
3 range outside of which it operates at a reduced efficiency, wherein said array controller
4 is programmed to operate said plurality of fan units at substantially peak efficiency by
5 strategically turning off at least one fan unit operating at reduced efficiency and running
6 the remaining fan units within said peak efficiency operating range.
7

1 13. The fan array fan section in an air-handling system of claim 1, further
2 comprising an array controller for controlling said plurality of fan units to run at
3 substantially peak efficiency by strategically turning selective ones of said plurality of fan
4 units on and off, said array controller programmed to operate said plurality of fan units
5 at peak efficiency for a performance level based on a criteria selected from the following
6 group of criteria:

- 7 (a) air volume;
8 (b) level of air flow;
9 (c) pattern of air flow; and
10 (d) number of fan units to operate.
11

1 14. The fan array fan section in an air-handling system of claim 1, further
2 comprising an array controller for controlling said plurality of fan units, said array
3 controller is programmed to operate said plurality of fan units to produce a stable
4 operating point and eliminate the surge effects.
5

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1 15. The fan array fan section in an air-handling system of claim 1, further
2 comprising an array controller for controlling said plurality of fan units, said array
3 controller is programmed to selectively control the speed of each of said plurality of fan
4 units to run at substantially peak efficiency.

5

1 16. A fan array fan section in an air-handling system comprising:

- 2 (a) an air-handling compartment;
- 3 (b) a plurality of independently controllable fan units;
- 4 (c) said plurality of fan units arranged in a fan array;
- 5 (d) said fan array having at least one fan unit arranged vertically on at
6 least one other fan unit;
- 7 (e) said fan array positioned within said air-handling compartment; and
- 8 (f) said air-handling compartment positionable within a structure such
9 that said air-handling system conditions the air of said structure.

10

1 17. The fan array fan section in an air-handling system of claim 1 further
2 comprising an array controller programmed to operate said plurality of fan units at peak
3 efficiency by strategically turning on and off selective ones of said plurality of fan units.

4

1 18. The fan array fan section in an air-handling system of claim 1, further
2 comprising an array controller, wherein each fan unit has a peak efficiency operating
3 range outside of which it operates at a reduced efficiency, wherein said array controller
4 is programmed to operate said plurality of fan units at substantially peak efficiency by
5 strategically turning off at least one fan unit operating at reduced efficiency and running
6 the remaining fan units within said peak efficiency operating range.

7

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1 19. The fan array fan section in an air-handling system of claim 1, further
2 comprising an array controller for controlling said plurality of fan units to run at
3 substantially peak efficiency by strategically turning selective ones of said plurality of fan
4 units on and off, said array controller programmed to operate said plurality of fan units
5 at peak efficiency for a performance level based on a criteria selected from the following
6 group of criteria:

- 7 (a) air volume;
8 (b) level of air flow;
9 (c) pattern of air flow; and
10 (d) number of fan units to operate.

11

1 20. The fan array fan section in an air-handling system of claim 1, further
2 comprising an array controller for controlling said plurality of fan units, said array
3 controller is programmed to selectively control the speed of each of said plurality of fan
4 units to run at substantially peak efficiency.

5

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DECLARATION (37 CFR 1.63) FOR UTILITY OR DESIGN APPLICATION USING AN APPLICATION DATA SHEET (37 CFR 1.76)

Title of Invention	FAN ARRAY FAN SECTION IN AIR-HANDLING SYSTEMS
<p>As the below named inventor(s), I/we declare that:</p> <p>This declaration is directed to:</p> <p><input checked="" type="checkbox"/> The attached application, or</p> <p><input type="checkbox"/> Application No. _____, filed on _____,</p> <p><input type="checkbox"/> as amended on _____ (if applicable);</p> <p>I/we believe that I/we am/are the original and first inventor(s) of the subject matter which is claimed and for which a patent is sought;</p> <p>I/we have reviewed and understand the contents of the above-identified application, including the claims, as amended by any amendment specifically referred to above;</p> <p>I/we acknowledge the duty to disclose to the United States Patent and Trademark Office all information known to me/us to be material to patentability as defined in 37 CFR 1.58, including for continuation-in-part applications, material information which became available between the filing date of the prior application and the national or PCT International filing date of the continuation-in-part application.</p> <p>All statements made herein of my/own knowledge are true, all statements made herein on information and belief are believed to be true, and further that these statements were made with the knowledge that willful false statements and the like are punishable by fine or imprisonment, or both, under 18 U.S.C. 1001, and may jeopardize the validity of the application or any patent issuing thereon.</p>	

FULL NAME OF INVENTOR(S)	
Inventor one: <u>Lawrence G. Hopkins</u>	Date: <u>June 15, 2005</u>
Signature: <u><i>Lawrence G. Hopkins</i></u>	Citizen of: <u>U.S.</u>
Inventor two: _____	Date: _____
Signature: _____	Citizen of: _____
Inventor three: _____	Date: _____
Signature: _____	Citizen of: _____
Inventor four: _____	Date: _____
Signature: _____	Citizen of: _____

☐ Additional inventors or a legal representative are being named on _____ additional form(s) attached hereto.

This collection of information is required by 35 U.S.C. 115 and 37 CFR 1.63. The information is required to obtain or retain a benefit by the public which is to file (and by the USPTO to process) an application. Confidentiality is governed by 35 U.S.C. 122 and 37 CFR 1.11 and 1.14. This collection is estimated to take 1 minute to complete, including gathering, preparing, and submitting the completed application form to the USPTO. Time will vary depending upon the individual case. Any comments on the amount of time you require to complete this form and/or suggestions for reducing the burden, should be sent to the Chief Information Officer, U.S. Patent and Trademark Office, U.S. Department of Commerce, P.O. Box 1450, Alexandria, VA 22313-1450. DO NOT SEND FEES OR COMPLETED FORMS TO THIS ADDRESS. SEND TO: Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450.

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Hunt:FanArr3

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POWER OF ATTORNEY and CORRESPONDENCE ADDRESS INDICATION FORM	Application Number	
	Filing Date	June 15, 2005
	First Named Inventor	Hopkins
	Title	FAN ARRAY FAN SECTION IN AIR-HANDLING SYSTEMS
	Art Unit	
	Examiner Name	
	Attorney Docket Number	Hunt/FanAr3

I hereby revoke all previous powers of attorney given in the above-identified application.

I hereby appoint:

☒ Practitioners associated with the Customer Number:

26790

OR

☐ Practitioner(s) named below:

Name	Registration Number

as my/our attorney(s) or agent(s) to prosecute the application identified above, and to transact all business in the United States Patent and Trademark Office connected therewith.

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Email

I am the:

☐ Applicant/Inventor.

☒ Assignee of record of the entire interest. See 37 CFR 3.71.
Statement under 37 CFR 3.73(b) is enclosed. (Form PTO/SB/08)

SIGNATURE of Applicant or Assignee of Record

Signature

Date June 15, 2005

Name

John E. Albert

Telephone (503) 639-0113

Title and Company

Chief Operating Officer of Huntair, Inc.

NOTE: Signatures of all the inventors or assignees of record of the entire interest or their representative(s) are required. Submit multiple forms if more than one signature is required, see below.

☒ Total of 2 forms are submitted.

This collection of information is required by 37 CFR 1.31, 1.32 and 1.33. The information is required to obtain or retain a benefit by the public which is to file (and by the USPTO to process) an application. Confidentiality is governed by 35 U.S.C. 122 and 37 CFR 1.11 and 1.14. This collection is estimated to take 3 minutes to complete, including gathering, preparing, and submitting the completed application form to the USPTO. Time will vary depending upon the individual case. Any comments on the amount of time you require to complete this form and/or suggestions for reducing this burden, should be sent to the Chief Information Officer, U.S. Patent and Trademark Office, U.S. Department of Commerce, P.O. Box 1450, Alexandria, VA 22313-1450. DO NOT SEND FEES OR COMPLETED FORMS TO THIS ADDRESS. SEND TO: Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450.

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POWER OF ATTORNEY and CORRESPONDENCE ADDRESS INDICATION FORM	Application Number	
	Filing Date	June 15, 2005
	First Named Inventor	Hopkins
	Title	FAN ARRAY FAN SECTION IN AIR-HANDLING SYSTEMS
	Art Unit	
	Examiner Name	
	Attorney Docket Number	Hunt FanAr3

I hereby revoke all previous powers of attorney given in the above-identified application.

I hereby appoint:

☒ Practitioners associated with the Customer Number: 26790

OR

☐ Practitioner(s) named below:

Name	Registration Number

as my/our attorney(s) or agent(s) to prosecute the application identified above, and to transact all business in the United States Patent and Trademark Office connected therewith.

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OR

☐ The address associated with Customer Number:

OR

☐ Firm or Individual Name

Address

City

State

Zip

Country

Telephone

Email

I am the:

☒ Applicant/Inventor.

☐ Assignee of record of the entire interest. See 37 CFR 3.71. Statement under 37 CFR 3.73(b) is enclosed. (Form PTO/SB/06)

SIGNATURE of Applicant or Assignee of Record

Signature	Date June 15, 2005
Name	Telephone (503) 639-0113
Title and Company	

NOTE: Signatures of all the inventors or assignees of record of the entire interest or their representative(s) are required. Submit multiple forms if more than one signature is required, see below.

☒ *Total of 2 forms are submitted.

This collection of information is required by 37 CFR 1.31, 1.32 and 1.33. The information is required to obtain or retain a benefit by the public which is to file (and by the USPTO to process) an application. Confidentiality is governed by 35 U.S.C. 122 and 37 CFR 1.11 and 1.14. This collection is estimated to take 3 minutes to complete, including gathering, preparing, and submitting the completed application form to the USPTO. Time will vary depending upon the individual case. Any comments on the amount of time you require to complete this form and/or suggestions for reducing this burden, should be sent to the Chief Information Officer, U.S. Patent and Trademark Office, U.S. Department of Commerce, P.O. Box 1450, Alexandria, VA 22313-1450. DO NOT SEND FEES OR COMPLETED FORMS TO THIS ADDRESS. SEND TO: Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450.

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STATEMENT UNDER 37 CFR 3.73(b)

Applicant/Patent Owner: Hopkins

Application No./Patent No.: _____ Filed/Issue Date: June 15, 2005

Entitled: FAN ARRAY FAN SECTION IN AIR-HANDLING SYSTEMS

HUNTAIR INC. a corporation

(Name of Assignee) (Type of Assignee, e.g., corporation, partnership, university, government agency, etc.)

states that it is:

1. ☒ the assignee of the entire right, title, and interest; or

2. ☐ an assignee of less than the entire right, title and interest.
The extent (by percentage) of its ownership interest is _____ %

in the patent application/patent identified above by virtue of either:

A. ☒ An assignment from the inventor(s) of the patent application/patent identified above. The assignment was recorded in the United States Patent and Trademark Office at Reel _____, Frame _____, or for which a copy thereof is attached.

OR

B. ☐ A chain of title from the inventor(s), of the patent application/patent identified above, to the current assignee as shown below:

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The document was recorded in the United States Patent and Trademark Office at Reel _____, Frame _____, or for which a copy thereof is attached.

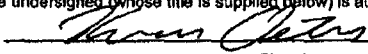
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☒ Copies of assignments or other documents in the chain of title are attached.
[NOTE: A separate copy (i.e., a true copy of the original assignment document(s)) must be submitted to Assignment Division in accordance with 37 CFR Part 3, if the assignment is to be recorded in the records of the USPTO. See MPEP 302.08]

The undersigned (whose title is supplied below) is authorized to act on behalf of the assignee.

 June 15, 2005

Signature Date

Karen Dana Oster (503) 810-2560

Printed or Typed Name Telephone Number

Patent Attorney 37,621

Title

This collection of information is required by 37 CFR 3.73(b). The information is required to obtain or retain a benefit by the public which is to file (and by the USPTO to process) an application. Confidentiality is governed by 35 U.S.C. 122 and 37 CFR 1.11 and 1.14. This collection is estimated to take 12 minutes to complete, including gathering, preparing, and submitting the completed application form to the USPTO. Time will vary depending upon the individual case. Any comments on the amount of time you require to complete this form and/or suggestions for reducing this burden, should be sent to the Chief Information Officer, U.S. Patent and Trademark Office, U.S. Department of Commerce, P.O. Box 1450, Alexandria, VA 22313-1450. DO NOT SEND FEES OR COMPLETED FORMS TO THIS ADDRESS. SEND TO: Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450.

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W 000/000

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DO NOT DETACH****ASSIGNMENT OF PATENT APPLICATION**

WHEREAS, I Lawrence G. Hopkins of Portland, OR have invented a FAN ARRAY FAN SECTION IN AIR-HANDLING SYSTEMS, hereinafter referred to as the "invention," for which on March 20, 2003 I filed U.S. Provisional Patent Application No. 60/458,413, for which on March 19, 2004 I filed PCT Patent Application Serial No. _____, for which on March 20, 2004 I filed U.S. Provisional Patent Application No. _____, and for which I am filing concurrently herewith a nonprovisional United States Letter Patent Application.

WHEREAS, HUNTAIR INC., an Oregon Corporation herein referred to as "Assignee" whose mailing address is 11555 SW Myskony Street, Tualatin, OR 97062 is desirous of acquiring the entire right, title, and interest in the same.

NOW, THEREFORE, in consideration of the sum of One Dollar (\$1.00), the receipt of which is hereby acknowledged, and other good and valuable consideration, I, by these presents do hereby sell, assign, and transfer unto the Assignee (1) the full and exclusive right to the invention for the United States and all foreign countries, (2) the entire right, title, and interest in and to any and all Patents which may be granted therefore, in the United States or any foreign country, and (3) any provisionals, nonprovisionals, divisions, continuations, continuations in part, improvements, reissues, or extensions that may be made or granted thereon, in the United States or any foreign country.

FURTHER, I agree to execute further instruments proper for effectuating the premises.

FURTHER, I hereby authorize and request the Commissioner of Patent and Trademarks to issue the patent(s) to the Assignee of the entire right, title, and interest in and to the same, for Assignee's sole use and behoof; and for the use and behoof of Assignee's legal representatives, to the full end of the term for which the patent(s) may be granted, as fully and entirely as the same would have been held by me had this assignment and sale not been made.

IT SHOULD BE NOTED that this assignment acknowledges and affirms the assignment document(s) of any related provisional application(s), divisional application(s), continuation application(s), continuation in part application(s), foreign (or PCT) application(s), improvements, reissue, and/or extension.

Dated March 22, 2004

Lawrence G. Hopkins
Lawrence G. Hopkins

State of Oregon
County of Washington

ACKNOWLEDGMENT

SS:

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Before me personally appeared said Lawrence G. Hopkins and acknowledged the foregoing instrument to be his free act and deed this 22nd day of March, 2004.

(SEAL)

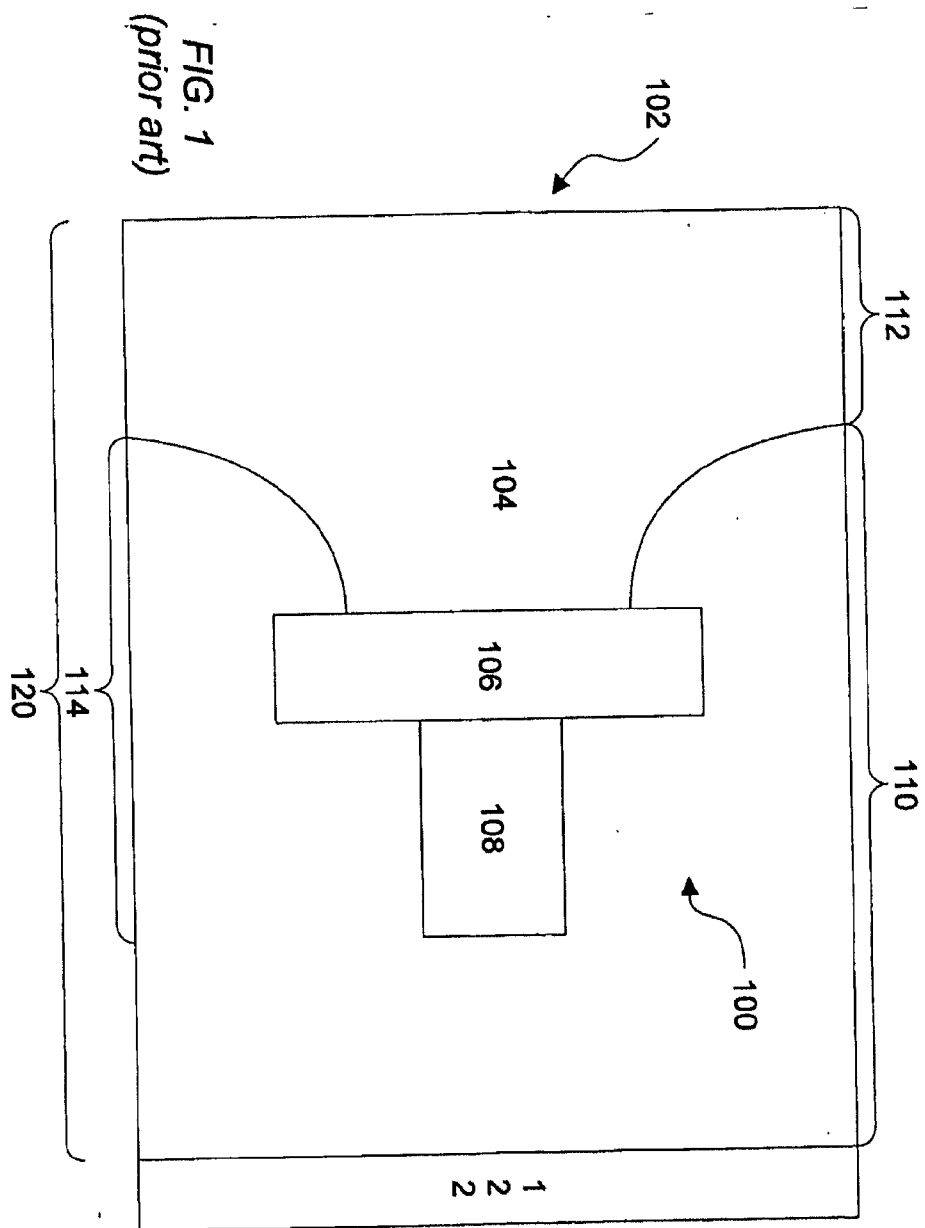


Brandy J. Hale
Notary Public for Oregon
My Commission Expires: 8/01/2004

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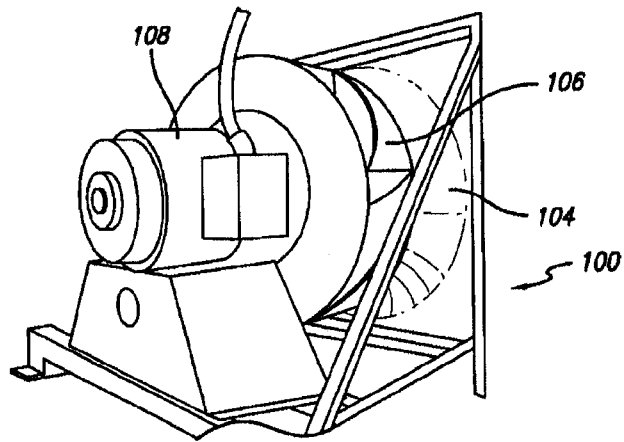
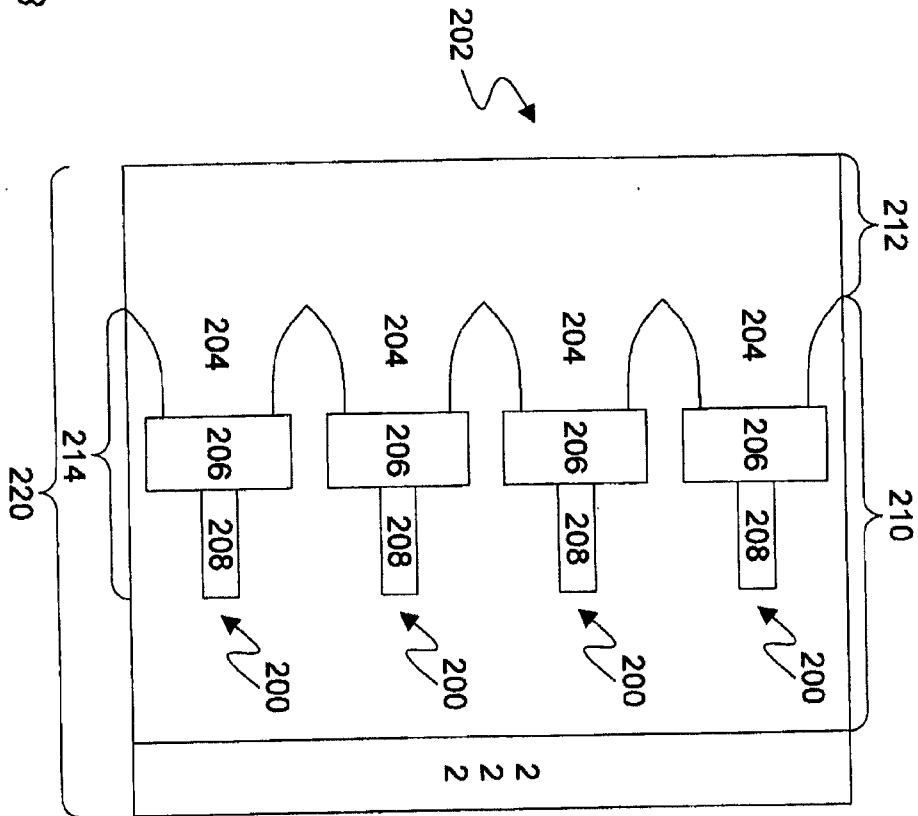


FIG. 2
(prior art)

FIG. 3




200	200	200	200	200	200
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200	200	200	200	200	200

FIG. 4

202

FIG. 5

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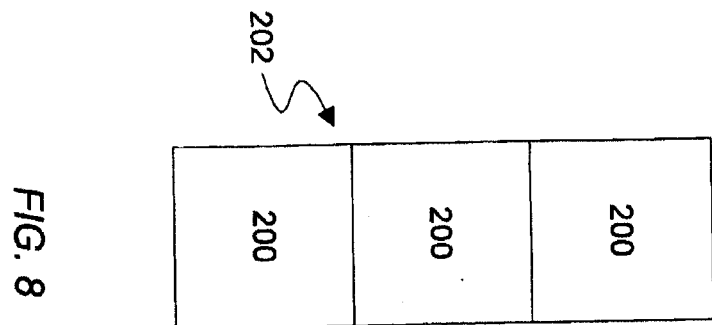
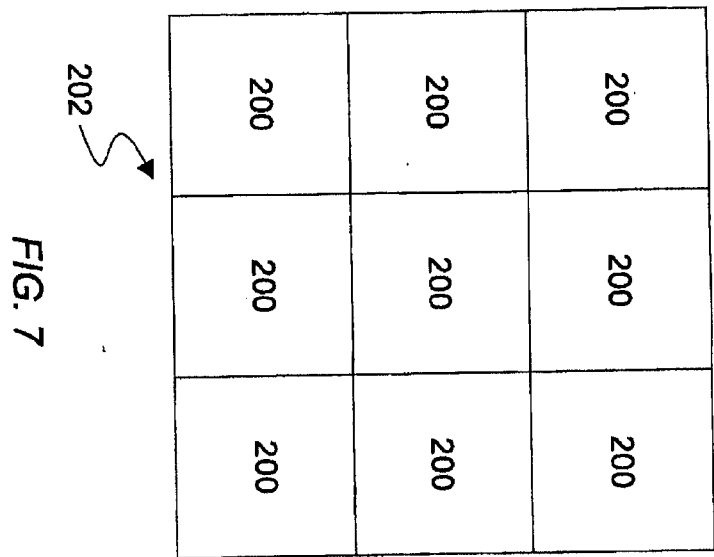


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200	200	200	200	200

200	200	200	200
200	200	200	200
200	200	200	200

202

FIG. 6



200	200	200
200	200	200
200	200	200

202

FIG. 9

	200		200		200
200		200		200	
	200		200		200
200		200		200	
	200		200		200
200		200		200	

202

FIG. 10

202

FIG. 12

202

FIG. 13

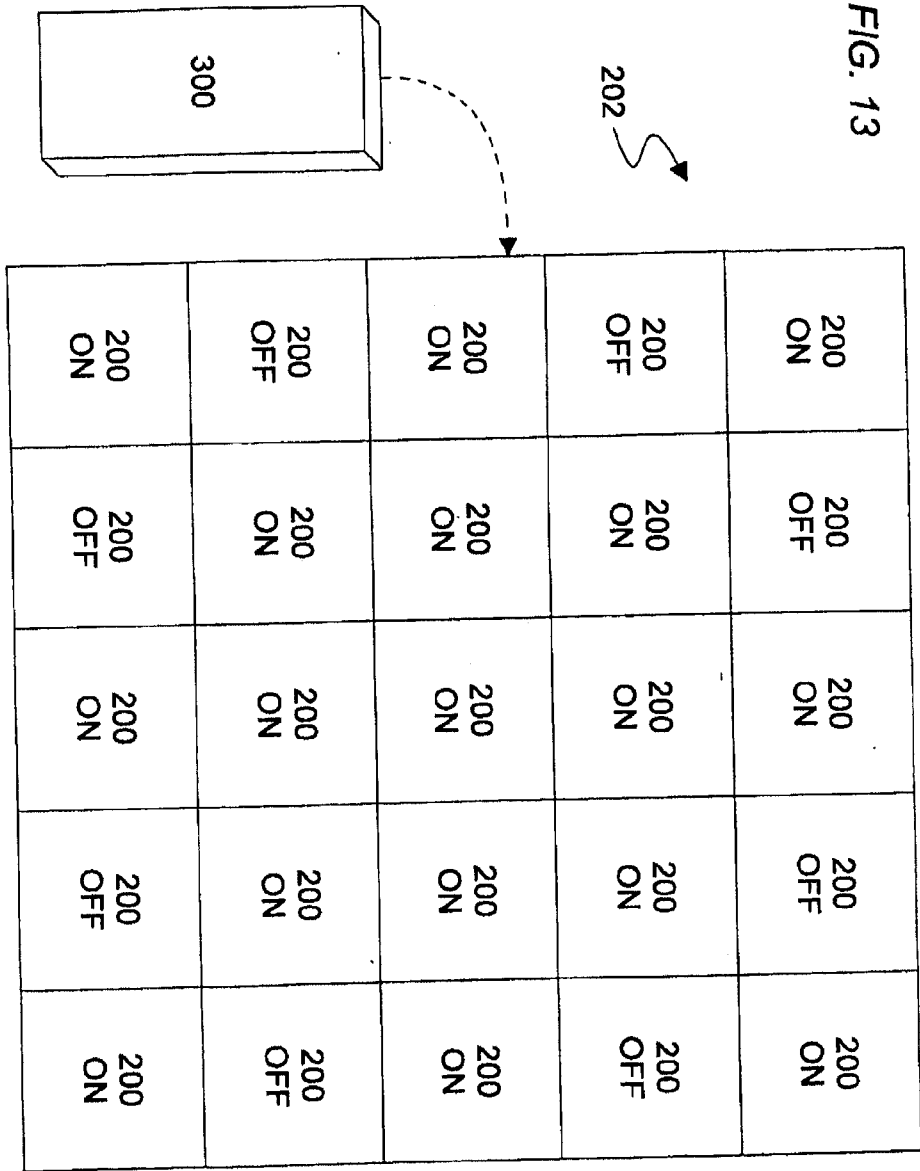
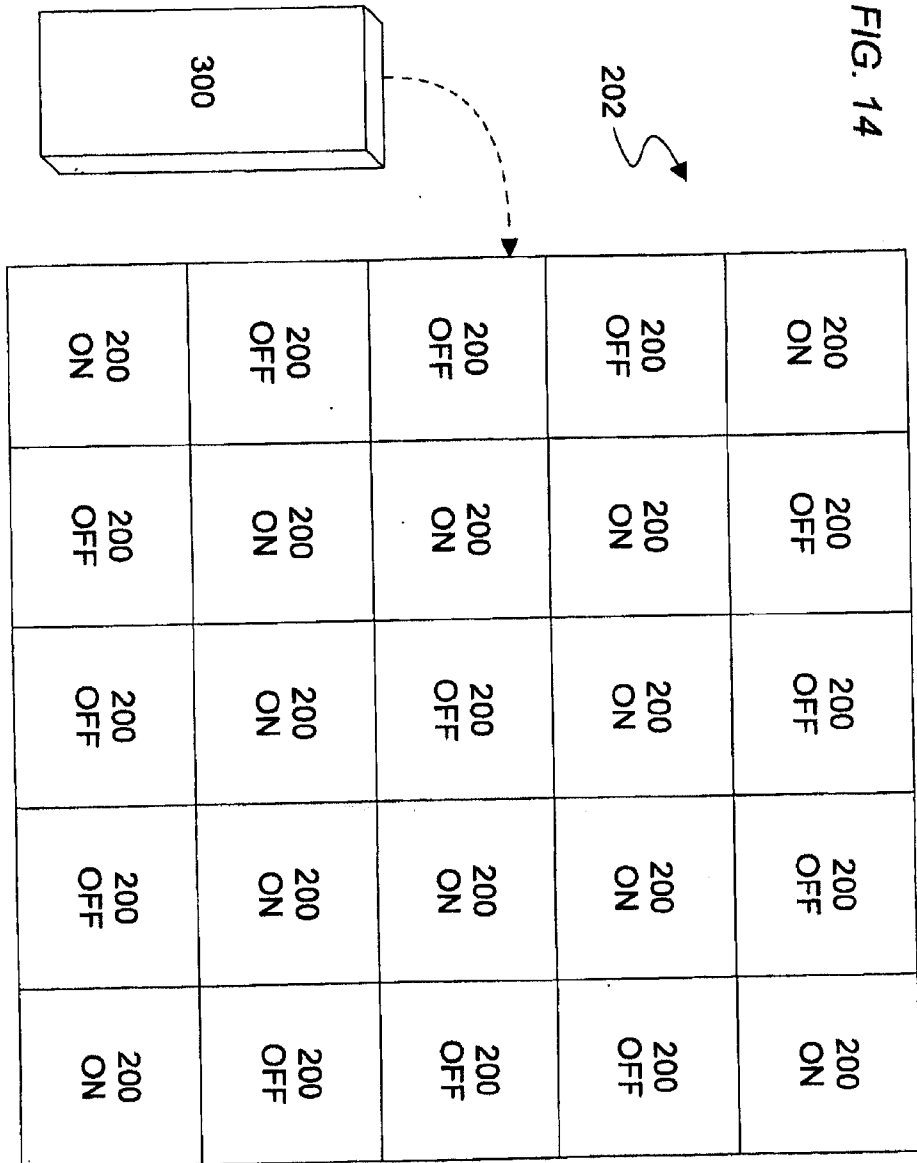


FIG. 14



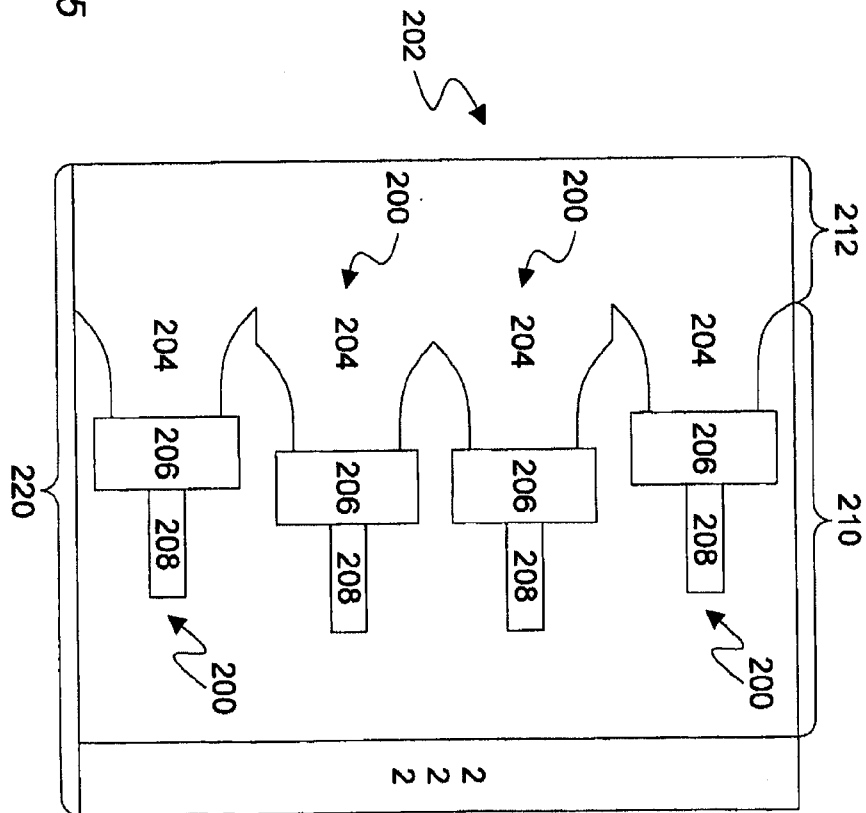


FIG. 15

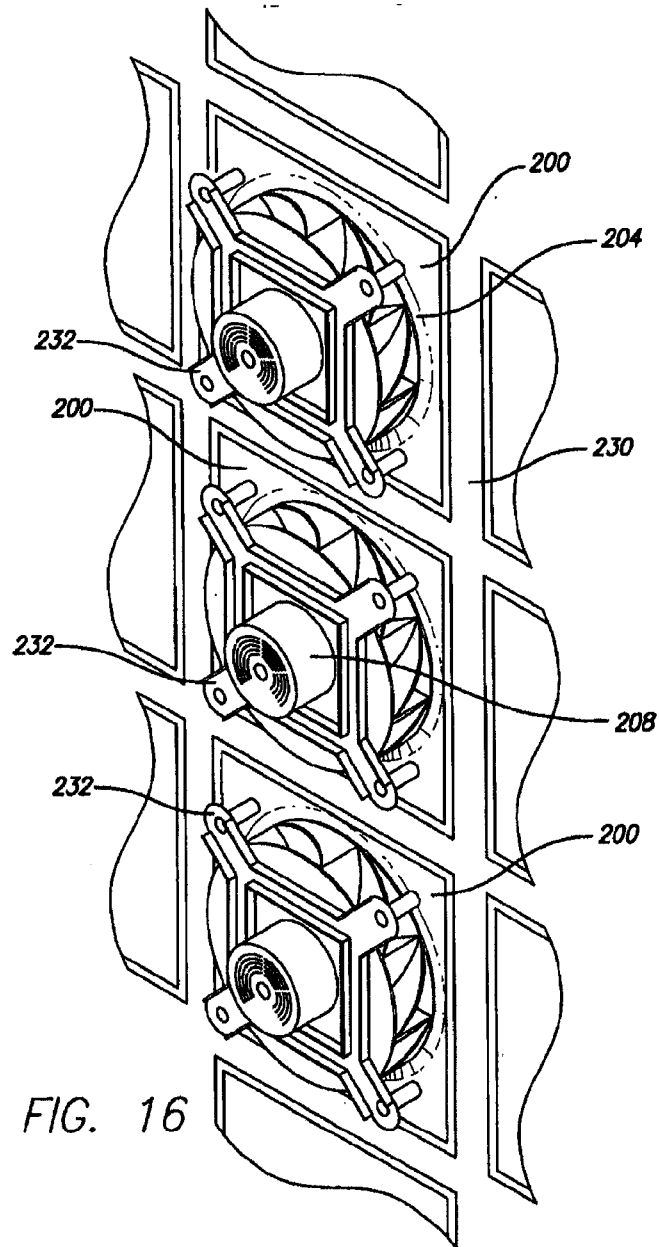


FIG. 16

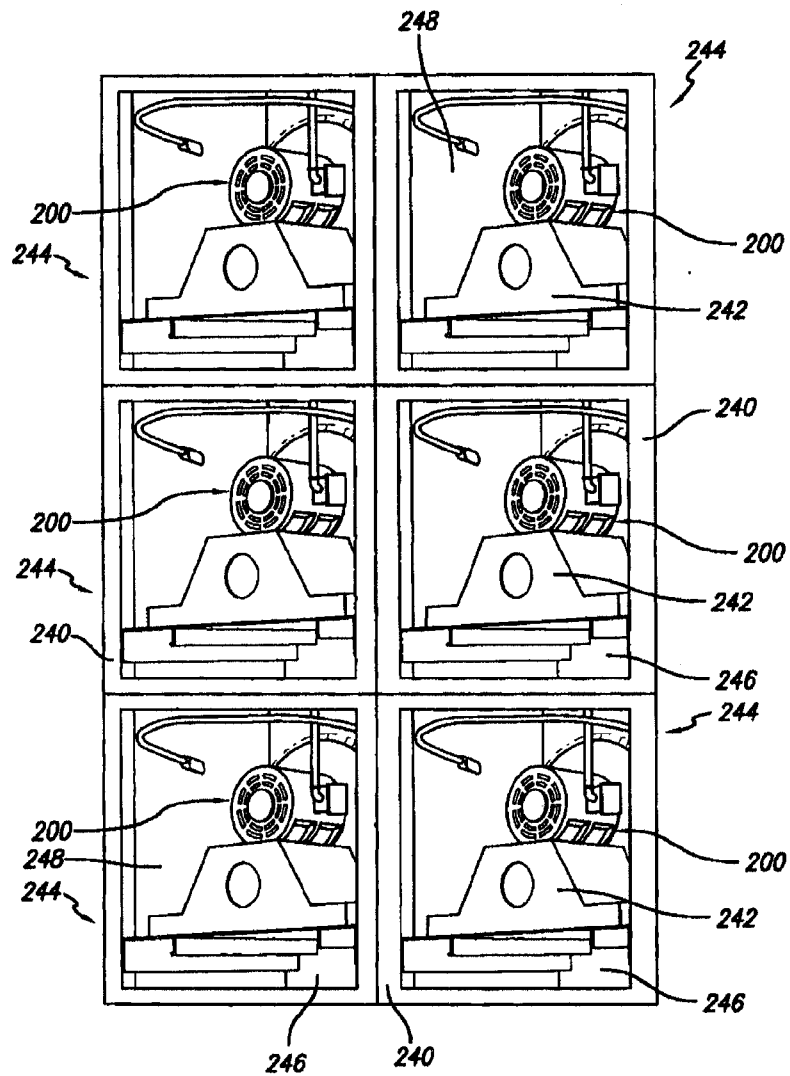


FIG. 17

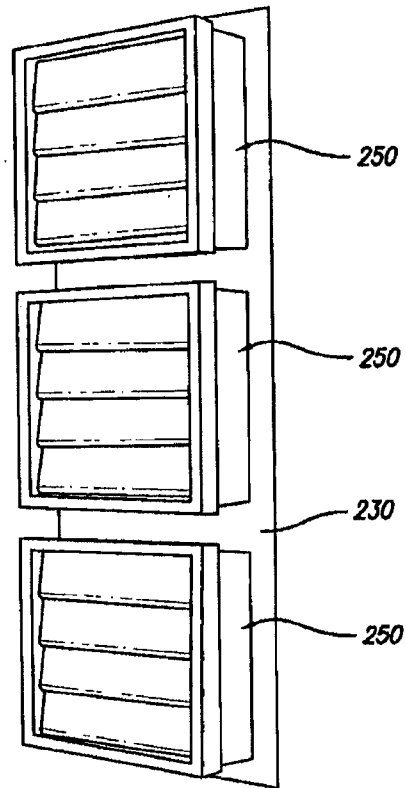


FIG. 18

APPLICATION DATA SHEET

Application Information

Application Number::	Concurrently Herewith
Filing Date::	June 15, 2005
Application Type::	Regular
Subject Matter::	Utility
Title::	FAN ARRAY FAN SECTION IN AIR-HANDLING SYSTEMS
Attorney Docket Number::	Hunt:FanArr3
Request For Early Publication::	No
Request For Non-Publication::	No
Suggested Drawing Figure::	
Total Drawing Sheets::	15
Small Entity::	Yes

Applicant Information

Applicant Authority Type::	Inventor
Primary Citizenship Country::	U.S.
Status::	Full Capacity
Given Name::	Lawrence
Middle Name::	G.
Family Name::	Hopkins
Name Suffix::	
City Of Residence::	Portland
State Or Province Of Residence::	Oregon
Country Of Residence::	U.S.

Street Of Mailing Address:: 10781 SE Idleman Rd.
City Of Mailing Address:: Portland
State Or Province Of Mailing Address:: Oregon
Country Of Mailing Address:: U.S.
Postal Or Zip Code Of Mailing Address:: 97266

Correspondence Information

Correspondence Customer Number:: 26790
Phone Number:: (503) 810-2560
Fax Number:: (503) 638-0367
E-Mail Address:: Karen@kdopatent.com

Representative Information

Representative Customer Number::	26790
----------------------------------	-------

Domestic Priority Information

Application::	Continuity Type::	Parent Application::	Parent Filing Date::
This Application	A continuation	10/806,775	03/22/04
10/806,775	An application claiming the benefit under 35 USC 119(e)	60/456,413	03/20/03
10/806,775	An application claiming the benefit under 35 USC 119(e)	60/554,702	03/20/04
10/806,775	A continuation in part	PCT/US2004/008578	03/19/04

Assignee Information

Assignee Name:: HUNTAIR INC.
 Primary Citizenship Country:: Oregon
 Street Of Mailing Address:: 11555 SW Myslony Street
 City Of Mailing Address:: Tualatin
 State Or Province Of Mailing Address:: Oregon
 Country Of Mailing Address:: USA
 Postal Or Zip Code Of Mailing Address:: 97062

CERTIFICATE UNDER 37 GFR 1.10
CERTIFICATE OF MAILING BY
"EXPRESS MAIL"

Express Mail No.: ET836240764US
Date of Deposit: June 15, 2005

I hereby certify that the following documents relating to a New U.S. Utility Patent Application entitled FAN ARRAY FAN SECTION IN AIR-HANDLING SYSTEMS and invented by Hopkins are being deposited with the United States Postal Service, "Express Mail Post Office to Addressee" service under 37 CFR 1.10, on the date indicated above and is addressed to Commissioner for Patents, P.O. Box 1450; Alexandria, VA 22313-1450.

- ☒ Utility Patent Application Transmittal Form (1 sheet(s))
- ☒ Specification (26 pages)
- ☒ Drawings (FIGS. 1-18)(15 sheets)
- ☒ Oath/Declaration(s)
- ☒ Patent Application Data Sheet
- ☒ Fee Transmittal Form (in duplicate) and check for \$500 for filing fees
- ☒ Information Disclosure Statement and attached non U.S. patent references
- ☒ Assignment, Recordation cover sheet, and check for \$40 for the assignment recordation fee
- ☒ Power(s) of Attorney from inventor(s) and assignee
- ☒ 373(b) form
- ☒ a return acknowledgement postcard
- ☒ this Certificate of Mailing by Express Mail



Karen Dana Oster

Hunt:FanArr3

H 000529

18351
 061505

PTO/IB/17 (12-04)
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Effective on 12/08/2004.
 Fees pursuant to the Consolidated Appropriations Act, 2005 (H.R. 4618).

FEE TRANSMITTAL

For FY 2005

☒ Applicant claims small entity status. See 37 CFR 1.27

TOTAL AMOUNT OF PAYMENT	(\$)	500
-------------------------	------	-----

Complete If Known	
Application Number	
Filing Date	June 15, 2005
First Named Inventor	Hopkins
Examiner Name	
Art Unit	
Attorney Docket No.	Hunt:FanArr3

METHOD OF PAYMENT (check all that apply)

☒ Check ☐ Credit Card ☐ Money Order ☐ None ☐ Other (please identify): _____

☒ Deposit Account Deposit Account Number: 50-2115 Deposit Account Name: _____

For the above-identified deposit account, the Director is hereby authorized to: (check all that apply)

☒ Charge fee(s) indicated below ☐ Charge fee(s) indicated below, except for the filing fee

☒ Charge any additional fee(s) or underpayments of fee(s) under 37 CFR 1.16 and 1.17 ☒ Credit any overpayments

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FEE CALCULATION

1. BASIC FILING, SEARCH, AND EXAMINATION FEES

Application Type	FILING FEES		SEARCH FEES		EXAMINATION FEES		Fees Paid (\$)
	Fee (\$)	Small Entity Fee (\$)	Fee (\$)	Small Entity Fee (\$)	Fee (\$)	Small Entity Fee (\$)	
Utility	300	150	500	250	200	100	500
Design	200	100	100	50	130	65	
Plant	200	100	300	150	160	80	
Reissue	300	150	500	250	600	300	
Provisional	200	100	0	0	0	0	

2. EXCESS CLAIM FEES

Fee Description	Fee (\$)	Small Entity Fee (\$)
Each claim over 20 or, for Reissues, each claim over 20 and more than in the original patent	50	25
Each independent claim over 3 or, for Reissues, each independent claim more than in the original patent	200	100
Multiple dependent claims	360	180

Total Claims 20 - 20 or HP = 0 x 25 = 0 **Fee Paid (\$)** 0

HP = highest number of total claims paid for, if greater than 20

Indep. Claims 2 - 3 or HP = 0 x 100 = 0 **Fee Paid (\$)** 0

HP = highest number of independent claims paid for, if greater than 3

3. APPLICATION SIZE FEE

If the specification and drawings exceed 100 sheets of paper, the application size fee due is \$250 (\$125 for small entity) for each additional 50 sheets or fraction thereof. See 35 U.S.C. 41(a)(1)(G) and 37 CFR 1.16(s).

Total Sheets	Extra Sheets	Number of each additional 50 or fraction thereof	Fee (\$)	Fee Paid (\$)
100	0	0	125	0

4. OTHER FEE(S)

Non-English Specification, \$130 fee (no small entity discount)

Other: _____

SUBMITTED BY

Signature	Registration No. 37,621	Telephone (503) 810-2560
Name (Print/Type) Karen Dana Oster	(Attorney/Agent)	Date June 15, 2005

This collection of information is required by 37 CFR 1.138. The information is required to obtain or retain a benefit by the public which is to file (and by the USPTO to process) an application. Confidentiality is governed by 35 U.S.C. 122 and 37 CFR 1.14. This collection is estimated to take 30 minutes to complete, including gathering, preparing, and submitting the completed application form to the USPTO. Time will vary depending upon the individual case. Any comments on the amount of time you require to complete this form and/or suggestions for reducing this burden, should be sent to the Chief Information Officer, U.S. Patent and Trademark Office, U.S. Department of Commerce, P.O. Box 1450, Alexandria, VA 22313-1450. DO NOT SEND FEES OR COMPLETED FORMS TO THIS ADDRESS. SEND TO: Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450.

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ORIGINAL
18351
U.S. PTO

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UTILITY
PATENT APPLICATION
TRANSMITTAL

(Only for new nonprovisional applications under 37 CFR 1.53(b))

Attorney Docket No. **Hunt:FanAr3**
 First Inventor **Hopkins**
 Title **FAN ARRAY FAN SECTION IN AIR-HANDLING SYSTEMS**
 Express Mail Label No. **ET836240764US**

APPLICATION ELEMENTS

See MPEP chapter 600 concerning utility patent application contents.

1. ☒ **Fee Transmittal Form** (e.g., PTO/SB/17) (and check)
(Submit on original and a duplicate for fee processing)
2. ☒ **Applicant claims small entity status.**
See 37 CFR 1.27.
3. ☒ **Specification** [Total Pages **26**]
Both the claims and abstract must start on a new page.
(For information on the preferred arrangement, see MPEP 801.01(a))
4. ☒ **Drawing(s)** (35 U.S.C. 113) [Total Sheets **15**]
5. **Oath or Declaration** [Total Sheets **1**]
 a. ☒ Newly executed (original or copy)
 b. ☐ A copy from a prior application (37 CFR 1.63(d))
 (for continuation/divisional with Box 18 completed)
 i. ☐ **DELETION OF INVENTOR(S)**
 Signed statement attached deleting inventor(s)
 name in the prior application, see 37 CFR
 1.63(d)(2) and 1.33(b).
 6. ☒ **Application Data Sheet.** See 37 CFR 1.76
 7. ☐ **CD-ROM or CD-R** in duplicate, large table or
 Computer Program (Appendix)
☐ Landscape Table on CD
 8. **Nucleotide and/or Amino Acid Sequence Submission**
 (if applicable, items a. - c. are required)
 a. **Computer Readable Form (CRF)**
 i. ☐ Computer Readable Form (CRF)
 ii. ☐ Transfer Request (37 CFR 1.821(e))
 b. **Specification Sequence Listing on:**
 i. ☐ CD-ROM or CD-R (2 copies); or
 ii. ☐ Paper
 c. ☐ Statements verifying identity of above copies

ADDRESS TO: **Commissioner for Patents**
P.O. Box 1450
Alexandria VA 22313-1450

ACCOMPANYING APPLICATION PARTS

9. ☒ **Assignment Papers** (cover sheet, documents, & \$40 check)
 Name of Assignee
HUNTAIR INC.
10. ☒ **37 CFR 3.73(b) Statement** ☒ **Power of Attorney**
 (when there is an assignee)
11. ☐ **English Translation Document** (if applicable)
12. ☒ **Information Disclosure Statement** (PTO/SB/08 or PTO-1449)
☒ Copies of foreign patent documents,
 publications, & other information
13. ☐ **Preliminary Amendment**
14. ☒ **Return Receipt Postcard** (MPEP 503)
 (Should be specifically itemized)
15. ☐ **Certified Copy of Priority Document(s)**
 (If foreign priority is claimed)
16. ☐ **Nonpublication Request** under 35 U.S.C. 122(b)(2)(B)(i).
 Applicant must attach form PTO/SB/35 or equivalent.
17. ☒ **certificate of express mail**

18. XXX The present application is a continuation application of U.S. Pat App #10/806,775. U.S. Pat App #10/806,775 is a nonprovisional application claiming the benefit under 35 USC Section 119(e) of U.S. Provisional Pat App #60/564,702. U.S. Pat App #10/806,775 is a nonprovisional application claiming the benefit under 35 USC Section 119(e) of U.S. Provisional Pat App #60/450,413. U.S. Pat App #10/806,775 is a CIP of PCT Pat App #PCT/US2004/008578.

Prior application information: Examiner **Nguyen, Ninh H.** Art Unit: **3745**

19. CORRESPONDENCE ADDRESS

☒ The address associated with Customer Number: **26790** OR ☐ Correspondence address below

Name	
Address	
City	State
Country	Zip Code
Telephone	Email Address
Signature	Date June 15, 2005
Name (Print/Type) Karen Dana Oster	Registration No. (Attorney/Agent) 37,621

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**INFORMATION DISCLOSURE
STATEMENT BY APPLICANT**

(Use as many sheets as necessary)

Sheet 1 of 4

Complete if Known

Application Number	11/154,894
Filing Date	June 15, 2005
First Named Inventor	Hopkins
Art Unit	37A 5
Examiner Name	N. NGUYEN
Attorney Docket Number	Hunt:FanAm3

U. S. PATENT DOCUMENTS

Examiner Initials*	Cite No. ¹	Document Number	Publication Date MM-DD-YYYY	Name of Patentee or Applicant of Cited Document	Pages, Columns, Lines, Where Relevant Passages or Relevant Figures Appear
		Number-Kind Code ² (if known)			
NHN		US- 3898019	08-05-1975	Reznick et al.	
		US- 4241871	12-30-1980	Newell, III et al.	
		US- 4426960	01-24-1984	Hart	
		US- 4800653	01-31-1989	Steffen	
		US- 5136465	08-04-1992	Benck et al.	
		US- 5210680	05-11-1993	Scheibler	
		US- 5546272	08-13-1996	Moss et al.	
		US- 5572403	11-05-1996	Mills	
		US- 5664995	09-09-1997	O'Keefe	
		US- 5745041	04-28-1998	Moss	
		US- 5787971	08-04-1998	Dodson	
		US- 5793610	08-11-1998	Schmitt et al.	
		US- 6031717	02-29-2000	Baddour et al.	
		US- 6257832 B1	07-10-2001	Lyskowski et al.	
		US- 6386826 B1	05-14-2002	Jacob	
		US- 6463891 B2	10-15-2002	Algrain et al.	
		US- 6,648,590 B2	11-18-2003	Huang et al.	
		US- 6,675,739 B2	01-13-2004	Terrell et al.	

FOREIGN PATENT DOCUMENTS

Examiner Initials*	Cite No. ¹	Foreign Patent Document	Publication Date MM-DD-YYYY	Name of Patentee or Applicant of Cited Document	Pages, Columns, Lines, Where Relevant Passages or Relevant Figures Appear	T ³
		Country Code ⁴ number ⁵ Kind Code ⁶ (if known)				
NHN		EP 0205979 A1	12-30-1986	Mizutani et al.		

Examiner
Signature

NHN H. Nguyen

Date
Considered

03/06/06

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PTO/SB/08a (08-03)

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**INFORMATION DISCLOSURE
STATEMENT BY APPLICANT**

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Sheet 2 of 4

Complete if Known

Application Number	11/154,894
Filing Date	June 15, 2005
First Named Inventor	Hopkins
Art Unit	3745
Examiner Name	N. NGUYEN
Attorney Docket Number	Hunt:FanAm3

U. S. PATENT DOCUMENTS

Examiner Initials*	Cite No.	Document Number	Publication Date MM-DD-YYYY	Name of Patentee or Applicant of Cited Document	Pages, Columns, Lines, Where Relevant Passages or Relevant Figures Appear
		Number-Kind Code ² (if known)			
NHN		US- 4767262	08-30-1988	Simon	
		US- 4133374	01-09-1979	York	
		US- 5632677	05-27-1997	Elkins	
		US- 6155335	12-05-2000	Acre et al.	
		US- 6386969 B1	05-14-2002	O'Brien	
		US- 6388880 B1	05-14-2002	El-Ghobashy et al.	
		US- 6407918 B1	06-18-2002	Edmunds et al.	
		US- 6414845 B2	07-02-2002	Bonet	
		US- 6427455 B1	08-06-2002	Furubayashi	
		US- 6436130	08-20-2002	Philips et al.	
NHN		US- 5370576	12-06-1994	Krofchak	
		US- 6072397	06-06-2000	Ostrowski	
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FOREIGN PATENT DOCUMENTS

Examiner Initials*	Cite No.	Foreign Patent Document	Publication Date MM-DD-YYYY	Name of Patentee or Applicant of Cited Document	Pages, Columns, Lines, Where Relevant Passages or Relevant Figures Appear	T ³
		Country Code ⁴ Number ⁴ Kind Code ⁴ (if known)				

Examiner Signature	<i>Mark H. Nguyen</i>	Date Considered	03/06/06
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INFORMATION DISCLOSURE STATEMENT BY APPLICANT (Use as many sheets as necessary)		Application Number	11/15A, 894
		Filing Date	June 15, 2005
		First Named Inventor	Hopkins
		Art Unit	3745
		Examiner Name	N. NGUYEN
Sheet 3 of 4	Attorney Docket Number	HuntFanAria	

NON PATENT LITERATURE DOCUMENTS			
Examiner Initials*	Cite No. ¹	Include name of the author (in CAPITAL LETTERS), title of the article (when appropriate), title of the item (book, magazine, journal, serial, symposium, catalog, etc.), date, page(s), volume-issue number(s), publisher, city and/or country where published.	T ²
glnm		The Parallel and Series Operation, Sunon Group web page, http://www.sunon.com/english/wealth/tech/tech-08.htm , at least as early as March 15, 2004, 2 pages, Sunon Group, Taiwan.	
		Series and Parallel Fans, HighBeam Research web page, http://static.highbeam.com/machinedesign/january/2005/seriesandparallelfans/index.htm , January 26, 1995, 1 page, HighBeam Research, LLC.	
		MCLEOD, IAN, Using Fans in Series and Parallel: Performance Guidelines, stampet web page, http://www.stampet.com/features/articles/en0084prnt-bus , at least as early as March 15, 2004, 3 pages, emb-Papet Automotive and Drives (UK) Ltd, UK.	
		Technical Bulletin: CLEANPAK M/R/PF Multi/Redundant/Plenum Fan, at least as early as March 15, 2004, 3 pages, CLEANPAK International, Cleckamas, Oregon.	
		Installation Operating and Maintenance Manual, 2003, 12 pages, Greenheck Fan Corp., Schofield, Wisconsin.	
		DPL Series - Delhi Plenum Fan: Installation and Maintenance Instructions, November 2001, 2 pages, Delhi Industries Inc., Delhi, Ontario, Canada.	
		AAON, RL Series Rooftop Conditioners, 09/01, 12 pages	
		Jim Parro (Marketing Manager for AAON) New Promotional Literature The RL Series, 1 page	
		AAON, RL Series 45 to 230 tons Packaged Rooftop Conditioners & Air Handlers	
glnm		AAON, Invoice No. 265184, 2/28/02, 1 page.	

Examiner Signature	<i>Thanh H. Nguyen</i>	Date Considered	03/06/06
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**INFORMATION DISCLOSURE
STATEMENT BY APPLICANT**

(Use as many sheets as necessary)

Sheet 4 of 4

Complete If Known

Application Number 11/154,894
 Filing Date June 15, 2005
 First Named Inventor Hopkins
 Art Unit 3745
 Examiner Name N. NGUYEN
 Attorney Docket Number HuntFanAm3

NON PATENT LITERATURE DOCUMENTS

Examiner Initials*	Cite No.	Include name of the author (in CAPITAL LETTERS), title of the article (when appropriate), title of the item (book, magazine, journal, serial, symposium, catalog, etc.), date, page(s), volume-issue number(s), publisher, city and/or country where published.	T ²
ahn		AACN, Order Form and Associated Documents, 11/14/01	
ahn		OSBORNE, W.C. and TURNER, C.G., co-editors, "Woods Practical Guide to Fan Engineering," 1964, cover pages and pages 121, 137-138, 146-148, 208, and 218, Benham and Company, Colchester, England.	
ahn		WILCKE, William F. and MOREY, R. Vance, "Selecting Fans, Determining Airflow for Crop Drying, Cooling, Storage," 1999, 8 pages, Regents of the University of Minnesota.	

Examiner Signature	Mark H. Nguyen	Date Considered	03/06/06
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*EXAMINER: Initial if reference considered, whether or not citation is in conformance with MPEP 608. Draw line through citation if not in conformance and not considered. Include copy of this form with next communication to applicant.

¹ Applicant's unique citation designation number (optional). ² Applicant is to place a check mark here if English language Translation is attached. This collection of information is required by 37 CFR 1.97 and 1.98. The information is required to obtain or retain a benefit by the public which is to file (and by the USPTO to process) an application. Confidentiality is governed by 35 U.S.C. 122 and 37 CFR 1.14. This collection is estimated to take 2 hours to complete, including gathering, preparing, and submitting the completed application form to the USPTO. Time will vary depending upon the individual case. Any comments on the amount of time you require to complete this form and/or suggestions for reducing this burden, should be sent to the Chief Information Officer, U.S. Patent and Trademark Office, U.S. Department of Commerce, P.O. Box 1450, Alexandria, VA 22313-1450. DO NOT SEND FEES OR COMPLETED FORMS TO THIS ADDRESS. SEND TO: Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450.

If you need assistance in completing the form, call 1-800-PTO-9199 and select option 2.

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H 000535



Express Mail No: EV 603557117 US

IN THE UNITED STATES PATENT AND
TRADEMARK OFFICE

Application Number: 11/154/894
 First Named Inventor: Lawrence G. Hopkins
 Filed: June 15, 2005
 Group Art Unit: 3744
 Title: Fan Array Fan Section in Air Handling Systems
 Attorney Docket: Hunt-FanArr3

SUBMISSION UNDER 37 C.F.R. 1.99 (a)

Pursuant to 37 C.F.R. 1.99 the following documents are submitted for consideration by the office in the above captioned application. A copy of each listed patent is enclosed herewith.

Patent Number	Date of Publication	First Named Inventor
US 3,332,621	07/25/1967	Tanner
US 4,158,527	06/19/1979	Burkett
US 4,494,006	01/15/1985	Staroselsky et al.
US 5,269,660	12/14/1993	Pradelle

As shown in the Proof of Service attached, a copy of this Submission and all documents listed have been served upon the applicant's attorney of record.

Finally, a fee under 37 C.F.R. 1.17(p) of \$180.00 has been included with this filing.

Dated this 20th day of December, 2005.

Respectfully Submitted,
SANTANGELO LAW OFFICES, P.C.

By:

Alfred K. Wiedmann Jr.
 Attorney for Submitter
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2/27/2005 DTESSEN1 00000055 11154894

1 FC:1806

180.00 DP

OK to enter. Complies with requirements
of 37 CFR 1.99 EK 26 MAY 2006

H 000536

Dated this 20th day of December, 2005.

Respectfully Submitted,
SANTANGELO LAW OFFICES, P.C.

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Express Mail No: EV 603557117 US

IN THE UNITED STATES PATENT AND
TRADEMARK OFFICE

Application Number: 11/154/894
First Named Inventor: Lawrence G. Hopkins
Filed: June 15, 2005
Group Art Unit: 3744
Title: Fan Array Fan Section in Air-Handling Systems
Attorney Docket: Hunt-FanArr3

PROOF OF SERVICE

The person whose signature appears below confirms that the attached Submission Under 37 C.F.R. 1.99 including a copy of all documents listed therein has been served upon the Applicant of the above captioned application in accordance with 37 C.F.R. §1.248 by transmitting a copy of the documents by first class mail to: Karen Dana Oster, Law Offices of Karen Dana Oster, LLC, PMB 1020, 15450 SW Boones Ferry Road #9, Lake Oswego, OR 97035, which mailing was made this same day.

Dated this 20th day of December, 2005.

Respectfully Submitted,

SANTANGELO LAW OFFICES, P.C.

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H 000538



Express Mail No: EV 603557117 US

IN THE UNITED STATES PATENT AND
TRADEMARK OFFICE

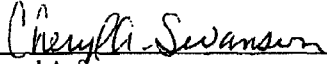
Application Number: 11/154/894
First Named Inventor: Lawrence G. Hopkins
Filed: June 15, 2005
Group Art Unit: 3744
Title: Fan Array Fan Section in Air-Handling Systems
Attorney Docket: Hunt-FanArr3

CERTIFICATE OF EXPRESS MAILING

I, Cheryl A. Swanson, hereby certify to the truth of the following items:

1. I am an employee of Santangelo Law Offices, P.C., 125 South Howes, Third Floor, Fort Collins, Colorado 80521.
2. I have this day deposited the attached Submission Under 37 C.F.R. 1.99 (a) including a listing of documents submitted for consideration by the office along with a copy of each document listed; Proof of Service pursuant to 37 C.F.R. 1.248; Letter of Transmittal along with a check payable to the Director of the Patent and Trademark Office in the amount of \$180.00; and this Express Mail Certificate and a return postcard with the United States Postal Service as "Express Mail" for mailing to: Commissioner for Patents, P.O. Box 1450, Alexandria VA 22313-1450.

Dated this 20th day of December 2005.


Cheryl A. Swanson

H 000539

United States Patent Office

3,332,621

Patented July 25, 1967

1

3,332,621

AUTOMATIC CONTROL MEANS

Basil Charles Tanner, London, England, assignor to Head Wrightson & Company Limited, London, England, a company of Great Britain

Filed Sept. 15, 1964, Ser. No. 396,578

Claims priority, application Great Britain, Oct. 10, 1963, 39,326/63

10 Claims. (Cl. 236-46)

The invention relates to automatic control means and particularly to the automatic control of fans for temperature regulation.

The invention has among its objects to provide means whereby the temperature of a cooling fluid flow is maintained between predetermined limits.

According to the invention temperature regulating means comprises thermostats effective, upon temperature changes, to move contacts to connect cam and timer means to a power supply whereby energisation, de-energisation or a speed change of one or more motor driven fans or the equivalent is effected.

According to the invention furthermore, the temperature regulation is carried out in a series of steps, the steps being spaced apart by determined time intervals so as to allow the temperature to stabilise.

According to the invention moreover two thermostats may be provided, one for increasing the quantity of air flow caused by the fans and one for decreasing the quantity of air flow caused by the fans.

According to the invention further, the cam means may be motor driven and the driving motor de-energised as soon as a timer is started, the timer means being de-energised after a predetermined time period, the cam driving motor being then re-energised if the exhaust of the fluid cooled by the fans is still outside predetermined limits.

The invention is diagrammatically illustrated by way of example in the accompanying drawings in which:

FIGURE 1 shows the basic circuit of the temperature regulating means of the invention;

FIGURES 2 and 3 show the circuit in greater detail and including minor modifications;

FIGURE 4 is a diagram illustrating the relationship between the cam switch operations and the position of the cam shaft.

Referring to FIGURE 1 a cam controller 1, driven by a motor 2, controls the power supply to four two-speed fan motors. A timer and motor 3 control the position of a contact 4. Relay R controls contacts R_1 to R_5 . Thermostats 5 and 6 close when the exhaust fluid from the system being cooled is too hot or too cold respectively having regard to the desired temperature of exhaust fluid.

In operation a single phase supply is applied to terminals N and L.

Assuming that all the fan motors are stationary and that the contact 5 is closed by the over-hot fluid. Contact R_4 is already closed, so that power is supplied through the closed forward limit switch 12 of the cam controller 1, to the motor 2.

The motor 2 rotates the cam controller 1 which closes the low speed contact on the first motor which then starts to run. Contact 7 is a wipe contact which supplies a momentary pulse to the timer 3. When the low speed contact closes, the dotted lines show the position when the contactor is closed. This pulse also energises relay R closing contact R_1 and opening contacts R_2 and R_3 . The motor 2 is thus de-energised and the cam controller 1 stops, but the timer 3 is energised through contact Tc which was closed by the energisation of timer 3. A delay period, governed by the setting of the timer, then ensues to allow the temperature of the exhaust to stabilise

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under the cooling action of the fan. At the end of the delay period the timer trips out, opening contact Tc and de-energising itself and the relay R. Contacts R_2 and R_3 then close and if contact 5 is still closed the cycle is repeated energising the second of the motors to run at low speed. This cycle is repeated at the intervals set by the timer until either contact 5 opens or all the motors are energised to run at high speed and the reverse limit switch 24 is closed and the forward limit switch 12 is opened thus de-energising the motor 2. An alarm is advantageously provided which operates if all the motors are running at high speed and contact 5 still remains closed, thus indicating that either the cooling equipment or the circuitry contains a fault.

The low speed and high speed contactors of each motor are ganged together so that the closing of one automatically opens the other. As the wipe contacts are provided to operate both on opening and on closing of the contactor no wipe contacts are necessary for the high speed contactors. In practice the wipe contacts can be operated by the fan motor starters instead of the cam shaft.

In the reverse operation to that described above, that is to say when the low thermostat contact 6 closes indicating an excessively cool exhaust fluid flow and the cam controller starts to switch motors from high speed down to low speed a time lag is provided so that the motor can run down from high speed, after the contactor is opened, to within a few r.p.m. of low speed before the low speed contactor is closed, mechanical shocks to shafts, gears and couplings are thus avoided.

So long as the contact 6 remains closed at the end of each timer period the cam controller 2 will rotate in the reverse direction until all the motors have been cut down to low speed and then until each motor is cut off completely and the reverse limit switch 24 opened. The forward limit switch 12 has already by then been reclosed and the equipment is thus ready for operation upon a temperature rise.

One suitable thermostat is the "Satchwell" type WT with 18° steps and a range of 40° F. to 170° F. with a 3° fixed differential, these thermostats are of robust construction and are well proven.

The "Rodene" multi-circuit camshaft timer is particularly suited for use in the invention as a cam controller and the "Rodene 7500" series timer is suitable for setting the time delay between steps as it is adjustable for periods between 1 and 72 minutes. This timer takes 10 seconds to reset from its maximum time period and the camshaft speed should therefore be set such as to give 15 seconds between switch operations, this ensures that the timer has reset and is ready for a further operation.

FIGURE 2 shows a modification of the control circuit of FIGURE 1.

The switches 8 and 9 correspond to the switches 5 and 6 of FIGURE 1 but are series connected so that the switch 9, for example, cannot cause reverse rotation of the camshaft controller unless the switch 8 has its contact in the opposite position to that necessary to cause forward rotation of the cam shaft. Shut down due to the thermostat malfunction is thus avoided. Contact 10 replaces contacts R_2 and R_3 in that it is opened by the energisation of the camshaft controller whilst the timer motor is running for the delay period. Contact 11 replaces contact 4 and is closed by the wipe contacts 7 of the low speed contactors thus supplying power to the timer motor 3.

In operation if the normally open contact of switch 8 closes indicating excess heat the motor 2 is connected to the power supply by way of switch 12 and rotates the cam controller 1 to close the low speed contactor of the first motor. Wipe contact 7 energises coil 13 closing contact 11, starting motor 3 and opening contact 10. The

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cam controller is stopped and light 14 being illuminated shows that the equipment is an automatic control. When the timer motor 3 trips out at the end of its period, contacts 10 and 11 close and open respectively and if the normally open contact of switch 8 is still in the closed position the cycle is repeated.

An automatic overcurrent spring circuit breaker 15 is provided and a switch 16 is provided for shut down at the end of a working day in a manner already described.

FIGURE 3 shows a further embodiment of the invention.

The form of temperature sensing shown is a mercury in glass thermometer 17 with probes 18, controlling, by way of relays 27 and 28, two thermostat contacts 19 and 20 which correspond to the previous contacts 5, 6, 8 and 9.

The layout shown in FIGURE 3 includes a pair of mains failure contacts 21, which connect with a relay 22, whereby a contact 23 is held in the operative position so long as there is power on the fan motor bus-bars. If the fan motor bus-bar supply fails during operation, but the single phase supply to the circuit is maintained, relay 22 moves to the position shown on the drawing thus cutting off the supply to clutch 24 and the cam controller 1 rotates to the off position in less than one second. This is to ensure that all the motors do not try to start together as soon as the bus bar supply is restored.

In operation contact 20 is usually in the other position to that shown and contact 19 is as shown. If the exhaust is too hot contact 19 moves to the right hand position, and contact 20 is in the right hand position, and therefore motor 2 is fed by breaker 15, contact 16, contact 25, contact 20, contact 19 and contact 12. Motor 2 rotates closing the low speed switch on the first motor and wipe contact 7. Wipe contact 7 energises relay 13 which switches contact 25 to the other position to that shown and starts the timer. Contact 25 also de-energises motor 2 but acts as a holding contact to the wipe contact 7 as it maintains the supply to the timer and to the clutch 13. Clutch 24 remains energised. Immediately before the low speed contact on the first motor closes, contact 26 closes in readiness for the return rotation when necessary. As before the delay period ensues whilst the timer is running, then the timer trips out and if contact 19 is still in the right hand position the cycle starts again.

The temperature sensing means 17 and 18 can be used to provide a permissible temperature band only one degree wide. The lower probe 18 shown is used as a common reference and movement of the mercury column due to a temperature extreme connects up the probes determining the boundaries of the temperature band and closes relays 27 and 28 to cause a circulating current through one of the rectifiers 29 and the transformer 30.

Energisation of relays 27 and 28 moves the contacts 19 and 20 respectively to the right hand position as shown. Thus at the desired temperature relay 27 is energised and relay 28 is not, contact 20 is in the opposite position to that shown and contact 19 is as shown. If the exhaust is too cool the contacts are in the position shown. If it is too hot both contacts 19 and 20 are in the opposite position to that shown.

Switch 16 in its normal position energises the circuits for normal sequential temperature control of the fan motor whereas in its alternate position switch 16 connects one side of the power line to motor 2 via contacts 26 to return the cams to their original positions.

The construction according to the invention is particularly suitable for the temperature control of water used as the heat transfer medium in a power generation cycle.

The water is fed through heating means and converted into steam. The steam drives a turbine and is then condensed and fed to cooling towers cooled by the fans controlled by the apparatus of the invention. The water passing downwardly from spray nozzles against a cooling air stream drawn upwardly by the fans. The water falls into

a reservoir pond from which it is drawn into the heating means again. The thermostat contacts 5 and 6, 8 and 9, 17 and 18 or 19 and 20 are advantageously provided either between the condenser and the cooling towers, or between the pond the heating means. The latter position allows for variations caused by atmospheric conditions and ensures a constant temperature of feed to the heating means at all times.

The construction according to the invention is also applicable to the cooling systems of nuclear reactors, particularly the cooling systems of small experimental reactors.

FIGURE 4 is a graph showing the energisation of the fans and limit switches at different angular displacements of the cam shaft from a zero position.

I claim:

1. Temperature regulating means comprising, in combination, at least one fan, a motor for driving each fan, a timer, at least one cam, electrical contacts operable by said cam effective to alter the power supplied to said motor from a power source, a cam driving motor and at least one thermostat effective, upon temperature change of a medium acted upon by said fan, to energise said cam driving motor, to rotate said cam, operate said electrical contacts, and effect a speed change of said motor, said timer being coupled to said electrical contacts so that operation of said electrical contacts being effective to energise said timer and de-energise said cam driving motor for a predetermined period of time.

2. Temperature regulating means as defined in claim 1, wherein the temperature regulation is carried out in steps, the period between said steps being preset on said timer, said timer being connected to de-energise itself at the end of the preset time period and being connected to re-energise said cam driving motor if said medium is still outside predetermined temperature limits.

3. Temperature regulating means as defined in claim 2, wherein two thermostats are provided, a first thermostat being effective, by means of said cam driving motor, said cam and said electrical contacts to raise the speed of said motor and a second thermostat being effective by means of said cam driving motor, said cam and said electrical contacts to reduce the speed of said motor, and in which an upper of said predetermined temperature limits can be set on said first thermostat and in which a lower of said predetermined temperature limits can be set on said second thermostat.

4. Temperature regulating means as defined in claim 1, wherein operation of said electrical contacts is effective to energise said timer and de-energise said cam driving motor by means of wipe contacts mounted on said electrical contacts.

5. Temperature regulating means as defined in claim 3, in which said cam driving motor can be supplied with power from a power source through an electrical contact on one of said first and second thermostats, the contacts on both said first and second thermostats being open when said medium is between said predetermined temperature limits.

6. Temperature regulating means comprising, in combination, at least one fan, a motor for driving each fan, a timer, at least one cam, electrical contacts operable by said cam effective to alter the power supplied to said motor from a power source, a cam driving motor and at least one thermostat, effective, upon temperature change of a medium acted upon by said fans, to energise said cam driving motor, to rotate said cam, operate said electrical contacts, and operate switch means by which switch means said motor is connectable to said power source, operation of said electrical contacts being effective to energise said timer and de-energise said cam driving motor.

7. Temperature regulating means as defined in claim 6, wherein the temperature regulation is carried out in steps, the period between said steps being preset on said

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timer, said timer being connected to de-energise itself at the end of the preset time period and being connected to re-energise said cam driving motor if said medium is still outside predetermined temperature limits.

8. Temperature regulating means as defined in claim 7, wherein two thermostats are provided, a first thermostat being effective, by means of said cam driving motor, said cam and said electrical contacts to connect said motor to said power source, and a second thermostat being effective by means of said cam driving motor, said cam and said electrical contacts to disconnect said motor from said power source, and in which an upper of said predetermined temperature limits can be set on said first thermostat and in which a lower of said predetermined temperature limits can be set on said second thermostat.

9. Temperature regulating means as defined in claim 6, wherein operation of said electrical contacts is effective to energise said timer and deenergise said cam driving

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motor by means of wipe contacts mounted on said electrical contacts.

10. Temperature regulating means as defined in claim 8, in which said cam driving motor can be supplied with power from a power source through an electrical contact on one of said first and second thermostats, the contacts on both said first and second thermostats being open when said medium is between said predetermined temperature limits.

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WILLIAM J. WYE, *Primary Examiner*.

ALDEN D. STEWART, *Examiner*.

H 000542

July 25, 1967

B. C. TANNER

3,332,621

AUTOMATIC CONTROL MEANS

Filed Sept. 15, 1964

3 Sheets-Sheet 1

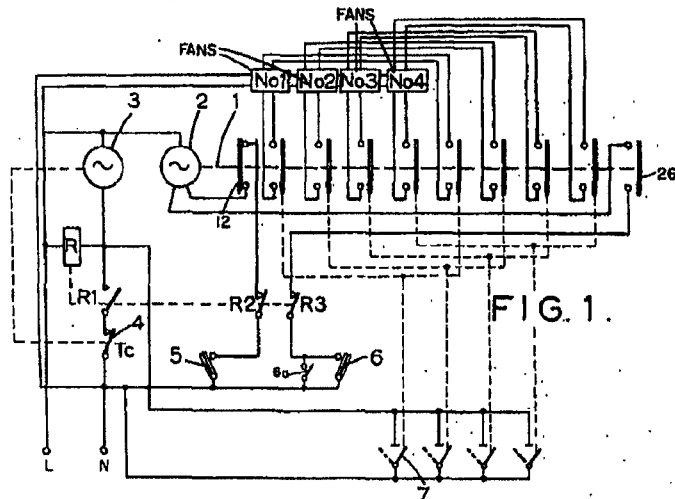


FIG. 1.

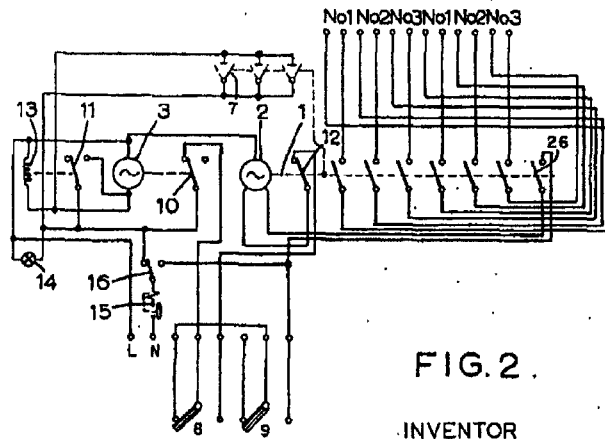


FIG. 2.

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BY
Morgan, Fenwick, Doolittle & Pines
ATTORNEY

July 25, 1967

B. C. TANNER

3,332,621

AUTOMATIC CONTROL MEANS

Filed Sept. 15, 1964

3 Sheets-Sheet 2

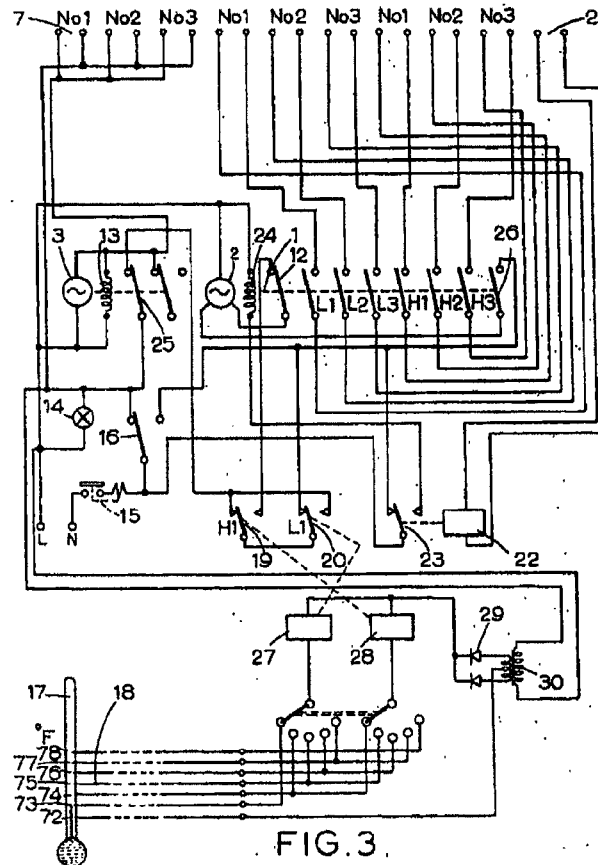


FIG. 3

INVENTOR

BASIL CHARLES TANNER

BY

Morgan, Finnegan, Graham & Rice
ATTORNEY

H 000544

July 25, 1967

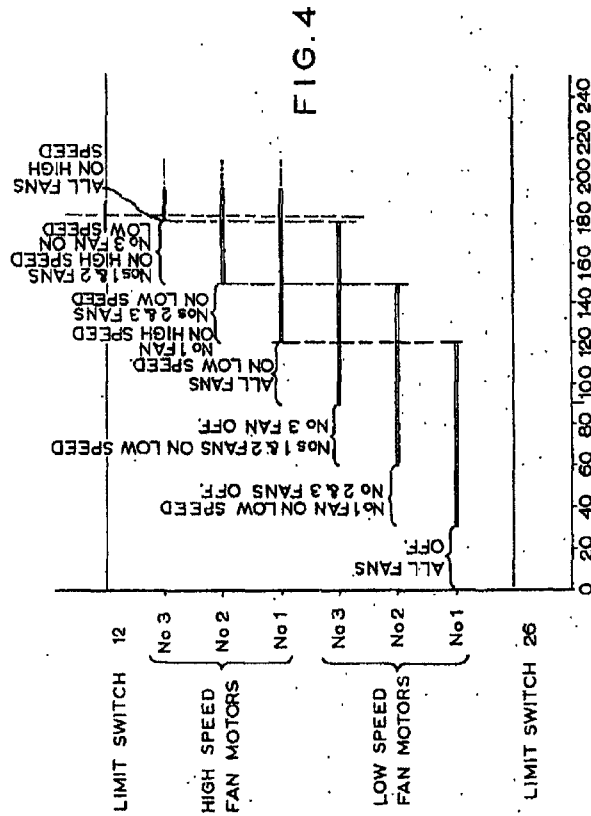
B. C. TANNER

3,332,621

AUTOMATIC CONTROL MEANS

Filed Sept. 15, 1964

3 Sheets-Sheet 3



INVENTOR

BASIL CHARLES TANNER

BY

Morgan, Finnegan, Dunham & Rice

ATTORNEY

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12-22-05

[Handwritten signature]



Express Mail No: EV 603557117US

IN THE UNITED STATES PATENT AND
TRADEMARK OFFICE

Application Number: 11/154/894
First Named Inventor: Lawrence G. Hopkins
Filed: June 15, 2005
Group Art Unit: 3744
Title: Fan Array Fan Section in Air-Handling Systems
Attorney Docket: Hunt-FanArr3

LETTER OF TRANSMITTAL

Commissioner for Patents
P.O. Box 1450
Alexandria VA 22313-1450

Enclosed for submission under 37 C.F.R. 1.99 (a) are the following documents:

1. a Submission Under 37 C.F.R. 1.99 (a) including a listing of documents submitted for consideration by the office along with a copy of each document listed;
2. a Proof of Service pursuant to 37 C.F.R. 1.248;
3. this Letter of Transmittal along with a check payable to the Director of the Patent and Trademark Office in the amount of \$180.00; and
4. an Express Mail Certificate and a return postcard.

Please confirm receipt of the documents by applying your date stamp and serial number on the enclosed postcard and returning it to me.

Please address all future correspondence to: Santangelo Law Offices, P.C., 125 South Howes, Third Floor, Fort Collins, CO 80521.

I have this 20th day of December, 2005, either myself personally or through my direction of staff at this office, deposited all of the items in the above letter of transmittal with the United States Postal Service as Express Mail, postage prepaid, in an envelope addressed to: Commissioner for Patents, P.O. Box 1450, Alexandria VA 22313-1450.



PTO/SB/81 (04-05)

Approved for use through 11/30/2005. OMB 0651-0035

U.S. Patent and Trademark Office, U.S. DEPARTMENT OF COMMERCE

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INDICATION FORM**

Application Number	11/154,884
Filing Date	08/16/2005
First Named Inventor	Lawrence G. Hopkins
Title	Fan Array Fan Section in Air- ...
Art Unit	3744
Examiner Name	Unknown
Attorney Docket Number	HTR007-3C US (new)

I hereby revoke all previous powers of attorney given in the above-identified application.

I hereby appoint:

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34036

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I am the:

☒ Applicant/Inventor.☐ Assignee of record of the entire interest. See 37 CFR 3.71.
Statement under 37 CFR 3.73(b) is enclosed. (Form PTO/SB/06)

SIGNATURE of Applicant or Assignee of Record

Signature		Date	12/21/05
Name	Lawrence G. Hopkins	Telephone	503-740-7610
Title and Company	R&D Director, Huntair, Inc.		

NOTE: Signatures of all the inventors or assignees of record of the entire interest or their representative(s) are required. Submit multiple forms if more than one signature is required, see below.

☒ *Total of 1 forms are submitted.

This collection of information is required by 37 CFR 1.51, 1.32 and 1.33. The information is required to obtain or retain a benefit by the public which is to file (and by the USPTO to process) an application. Confidentiality is governed by 35 U.S.C. 122 and 37 CFR 1.11 and 1.14. This collection is estimated to take 3 minutes to complete, including gathering, preparing, and submitting the completed application form to the USPTO. Time will vary depending upon the individual case. Any comments on the amount of time you require to complete this form and/or suggestions for reducing this burden, should be sent to the Chief Information Officer, U.S. Patent and Trademark Office, U.S. Department of Commerce, P.O. Box 1450, Alexandria, VA 22313-1450. DO NOT SEND FEES OR COMPLETED FORMS TO THIS ADDRESS. SEND TO: Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450.

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H 000547



PTO/SB/21 (09-04)

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**TRANSMITTAL
FORM**

(To be used for all correspondence after initial filing)

Total Number of Pages in This Submission

2

Application Number	11/154,894
Filing Date	06/16/2006
First Named Inventor	Lawrence G. Hopkins
Art Unit	3744
Examiner Name	Unknown
Attorney Docket Number	HTR007-3C US (new)

ENCLOSURES (Check all that apply)

<input type="checkbox"/> Fee Transmittal Form <input type="checkbox"/> Fee Attached <input type="checkbox"/> Amendment/Reply <input type="checkbox"/> After Final <input type="checkbox"/> Affidavits/declaration(s) <input type="checkbox"/> Extension of Time Request <input type="checkbox"/> Express Abandonment Request <input type="checkbox"/> Information Disclosure Statement <input type="checkbox"/> Certified Copy of Priority Document(s) <input type="checkbox"/> Reply to Missing Parts/Incomplete Application <input type="checkbox"/> Reply to Missing Parts under 37 CFR 1.52 or 1.53	<input type="checkbox"/> Drawing(s) <input type="checkbox"/> Licensing-related Papers <input type="checkbox"/> Petition <input type="checkbox"/> Petition to Convert to a Provisional Application <input checked="" type="checkbox"/> Power of Attorney, Revocation <input type="checkbox"/> Change of Correspondence Address <input type="checkbox"/> Terminal Disclaimer <input type="checkbox"/> Request for Refund <input type="checkbox"/> CD, Number of CD(s) _____ <input type="checkbox"/> Landscape Table on CD	<input type="checkbox"/> After Allowance Communication to TC <input type="checkbox"/> Appeal Communication to Board of Appeals and Interferences <input type="checkbox"/> Appeal Communication to TC (Appeal Notice, Brief, Reply Brief) <input type="checkbox"/> Proprietary Information <input type="checkbox"/> Status Letter <input checked="" type="checkbox"/> Other Enclosure(s) (please identify below): Return Postcard
Remarks Please charge Deposit Account No. 50-2263 for any fee(s) due. Please note that a new attorney docket number (see above) has been assigned to this application.		

SIGNATURE OF APPLICANT, ATTORNEY, OR AGENT

Firm Name	Silicon Valley Patent Group LLP		
Signature			
Printed name	David E. Stauber		
Date	01/04/2006	Reg. No.	25,557

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Signature	
Typed or printed name	David E. Stauber
Date	01/04/2006

This collection of information is required by 37 CFR 1.5. The information is required to obtain or retain a benefit by the public which is to file (and by the USPTO to process) an application. Confidentiality is governed by 35 U.S.C. 122 and 37 CFR 1.11 and 1.14. This collection is estimated to take 2 hours to complete, including gathering, preparing, and submitting the completed application form to the USPTO. Time will vary depending upon the individual case. Any comments on the amount of time you require to complete this form and/or suggestions for reducing this burden, should be sent to the Chief Information Officer, U.S. Patent and Trademark Office, U.S. Department of Commerce, P.O. Box 1450, Alexandria, VA 22313-1450. DO NOT SEND FEES OR COMPLETED FORMS TO THIS ADDRESS. SEND TO: Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450.

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H 000548



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United States Patent and Trademark Office
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www.uspto.gov

APPLICATION NUMBER	FILING OR 371 (c) DATE	FIRST NAMED APPLICANT	ATTY. DOCKET NO./TITLE
11/154,894	06/15/2005	Lawrence G. Hopkins	Hunt:FanArr3

CONFIRMATION NO. 2747

26790
LAW OFFICE OF KAREN DANA OSTER, LLC
PMB 1020
15450 SW BOONES FERRY ROAD #9
LAKE OSWEGO, OR 97035



OCC00000017834936

Date Mailed: 01/12/2006

NOTICE REGARDING CHANGE OF POWER OF ATTORNEY

This is in response to the Power of Attorney filed 01/06/2006.

- The Power of Attorney to you in this application has been revoked by the applicant. Future correspondence will be mailed to the new address of record(37 CFR 1.33).

BERHANU GIRUM
PTOSS (703) 305-0677

OFFICE COPY

H 000550



IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

Inventors: Lawrence G. Hopkins; ;
Assignee: Huntair, Inc.
Title: Fan Array Fan Section In Air-Handling Systems
Serial No.: 11/154,894 Filing Date: 06/15/2005
Examiner: Unknown Group Art Unit: 3744
Docket No.: HTR007-3C US Confirmation No: 2747

Santa Clara, California
January 11, 2006

COMMISSIONER FOR PATENTS
P.O. BOX 1450
ALEXANDRIA, VA 22313-1450

**SUPPLEMENTAL INFORMATION DISCLOSURE STATEMENT
UNDER 37 CFR §1.97(b)**

Dear Sir:

Pursuant to 37 C.F.R. § 1.56, §1.97 and §1.98, the Applicants submit for consideration in the above-identified patent application the documents listed on the accompanying Form PTO-1449. The Examiner is requested to make these documents of record.

This Information Disclosure Statement is submitted pursuant to 37 CFR §1.97(b) as it within three months of the filing date of a national application other than a continued prosecution application and/or before the mailing of a first Office Action on the merits. Accordingly, no fee is required.

Applicants would appreciate the Examiner initialing and returning the Form PTO-1449, indicating that the information has been considered and made of record herein.

Applicants also call the Examiner's attention to the following pending U.S. Applications which are related to this application and are listed on the enclosed Form PTO-1449:

Application No. 10/806,775, filed 03/22/2004.

Application No. 11/097,561, filed 03/31/2005.

SILICON VALLEY
PATENT GROUP LLP
150 Mission College Blvd.
Suite 360
Santa Clara, CA 95054
(408) 987-4320
FAX (408) 987-4310

-1-

Application No. 11/097,561

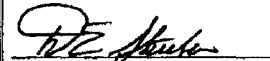
H 000551

Applicants presume that the Examiner has access to the file histories of the above U.S. applications and hence to the claims and arguments made in support of and against such claims in those applications. If this presumption is incorrect in any respect, the Applicants request the Examiner to so inform them so that the Applicants may submit copies of any materials that are unavailable to the Examiner.

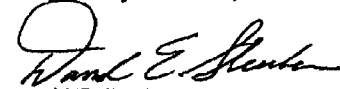
The information contained in this Information Disclosure Statement is to the best of my knowledge and is not to be construed as a representation that: (i) a complete search has been made; (ii) additional information material to the examination of this application does not exist; (iii) the information, protocols, results and the like reported by third parties are accurate or enabling; or (iv) the above information constitutes prior art to the subject invention.

CERTIFICATE OF MAILING BY "FIRST CLASS"

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David E. Steuber


Respectfully submitted,



David E. Steuber
Attorney for Applicants
Reg. No. 25,557

SILICON VALLEY
PATENT GROUP LLC
359 Mission College Blvd
Suite 360
Santa Clara, CA 95054
(408) 961-8200
FAX (408) 961-8210

Sheet 1 of 1

U.S. Department of Commerce, Patent and Trademark Office  INFORMATION DISCLOSURE STATEMENT BY APPLICANT (Attach several sheets if necessary)	Application No.:	11/154,894
	Filing Date:	06/15/2005
	First Named Inventor:	Lawrence G. Hopkins
	Group Art Unit:	3744 3745
	Examiner Name:	Unknown N. NGUYEN
	Confirmation No.:	2747
Attorney Docket No.:		HTR007-3C US

U.S. Patent Documents							
*Examiner Initials		Document Number	Date	Name	Class	Subclass	Filing Date if Appropriate
qlm	1.	4,651,922	04-1987	Noba	236	35	
	2.	4,494,006	01-1985	Staroselsky et al.	290	4	
	3.	4,158,527	06-1979	Burkett	417	18	
	4.	3,332,621	07-1967	Tanner	236	46	
	5.	5,269,660	12-1993	Pradelle	417	18	
	6.	2004-0185771A1	09-2004	Hopkins	415	119	
qlm	7.	2005-0180846A1	08-2005	Hopkins			
Foreign Patent Documents							
							Translation
		Document	Date	Country	Class	Subclass	Yes No
Other Art (Including Author, Title, Date, Pertinent Pages, Etc.)							
qlm	8.	AAON worksheet and drawing regarding Borders East Tower job for customer Borders Group, dated 02/26/2001 (2 pages)					
	9.	AAON order form, estimating worksheet, and facsimile transmission regarding The Commons job, dated 09/15/1998, 09/30/1998 and 6/30/1998 (3 pages)					
	10.	AAON wiring diagram assignment and verification regarding Form Show Arena job, 04/01/2002 (1 page)					
	11.	AAON worksheet and drawing regarding Harrison Wills job, both dated 02/26/2002 (2 pages)					
	12.	AAON RL Feature Master Number sheet, dated 10/17/2001 (1 page)					
qlm	13.	Mammoth Selection Guide for Custom Penthouse (200-410 Tons Cooling-only VAV configurations, 1992 (14 pages)					

Examiner: <i>Chuk H. Nguyen</i>	Date Considered: <i>03/06/06</i>
* Examiner: Initial if reference is considered, whether or not citation is in conformance with MPEP 609; Draw line through citation if not in conformance and not considered. Include copy of this form with your communication with applicant.	

H 000553



PTO/SB/21 (09-04)

Approved for use through 07/31/2006. OMB 0651-0031

U.S. Patent and Trademark Office, U.S. DEPARTMENT OF COMMERCE

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TRANSMITTAL FORM <small>(to be used for all correspondence after initial filing)</small>	Application Number	11/154,894
	Filing Date	05/15/2005
	First Named Inventor	Lawrence G. Hopkins
	Art Unit	3744
	Examiner Name	Unknown
	Attorney Docket Number	HTR007-3C US
Total Number of Pages in This Submission		27

ENCLOSURES (Check all that apply)		
<input type="checkbox"/> Fee Transmittal Form <input type="checkbox"/> Fee Attached <input type="checkbox"/> Amendment/Reply <input type="checkbox"/> After Final <input type="checkbox"/> Affidavits/declaration(s) <input type="checkbox"/> Extension of Time Request <input type="checkbox"/> Express Abandonment Request <input checked="" type="checkbox"/> Information Disclosure Statement <input type="checkbox"/> Certified Copy of Priority Document(s) <input type="checkbox"/> Reply to Missing Parts/Incomplete Application <input type="checkbox"/> Reply to Missing Parts under 37 CFR 1.52 or 1.53	<input type="checkbox"/> Drawing(s) <input type="checkbox"/> Licensing-related Papers <input type="checkbox"/> Petition <input type="checkbox"/> Petition to Convert to a Provisional Application <input type="checkbox"/> Power of Attorney, Revocation <input type="checkbox"/> Change of Correspondence Address <input type="checkbox"/> Terminal Disclaimer <input type="checkbox"/> Request for Refund <input type="checkbox"/> CD, Number of CD(s) _____ <input type="checkbox"/> Landscape Table on CD	<input type="checkbox"/> After Allowance Communication to TC <input type="checkbox"/> Appeal Communication to Board of Appeals and Interferences <input type="checkbox"/> Appeal Communication to TC (Appeal Notice, Brief, Reply Brief) <input type="checkbox"/> Proprietary Information <input type="checkbox"/> Status Letter <input checked="" type="checkbox"/> Other Enclosure(s) (please identify below): Return Postcard
Remarks Please charge Deposit Account No. 50-2263 for any fee(s) due.		

SIGNATURE OF APPLICANT, ATTORNEY, OR AGENT

Firm Name	Silicon Valley Patent Group LLP		
Signature	<i>David E. Steuber</i>		
Printed name	David E. Steuber		
Date	01/11/2006	Reg. No.	25,557

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Signature	<i>David E. Steuber</i>		
Typed or printed name	David E. Steuber	Date	01/11/2006

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H 000554



IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

Inventors: Lawrence G. Hopkins
Assignee: Huntair, Inc.
Title: Fan Array Fan Section In Air-Handling Systems
Serial No.: 11/154,894 Filing Date: 06/152005
Examiner: Ninh H. Nguyen Group Art Unit: 3744
Docket No.: HTR007-3C US Confirmation No: 2747

Santa Clara, California
February 22, 2006

MAIL STOP AMENDMENT
COMMISSIONER FOR PATENTS
P.O. BOX 1450
ALEXANDRIA, VA 22313-1450

**SUPPLEMENTAL INFORMATION DISCLOSURE STATEMENT
UNDER 37 CFR §1.97(b)**

Dear Sir:

Pursuant to 37 C.F.R. § 1.56, §1.97 and §1.98, the Applicants submit for consideration in the above-identified patent application the documents listed on the accompanying Form PTO-1449. The Examiner is requested to make these documents of record.

This Information Disclosure Statement is submitted pursuant to 37 CFR §1.97(b) as it within three months of the filing date of a national application other than a continued prosecution application and/or before the mailing of a first Office Action on the merits. Accordingly, no fee is required.

Applicants would appreciate the Examiner initialing and returning the Form PTO-1449, indicating that the information has been considered and made of record herein.

Applicants presume that the Examiner has access to the file histories of the pending U.S. applications listed on the enclosed Form PTO-1449 and hence to the claims and arguments made in support of and against such claims in those applications. If this presumption is incorrect in any respect, the Applicants request the Examiner to so inform

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-1-

Application No. 11/154,894

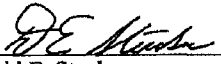
H 000555

them so that the Applicants may submit copies of any materials that are unavailable to the Examiner.

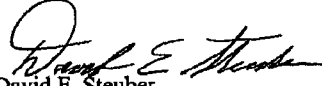
The information contained in this Information Disclosure Statement is to the best of my knowledge and is not to be construed as a representation that: (i) a complete search has been made; (ii) additional information material to the examination of this application does not exist; (iii) the information, protocols, results and the like reported by third parties are accurate or enabling; or (iv) the above information constitutes prior art to the subject invention.

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David E. Steuber

Respectfully submitted,


David E. Steuber
Attorney for Applicants
Reg. No. 25,557

SILICON VALLEY
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FAX (408) 962-8210



PTO/SB/08A (07-05)
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Substitute for form 1449/PTO

INFORMATION DISCLOSURE STATEMENT BY APPLICANT

(Use as many sheets as necessary)

Sheet 1 of 1

Complete if Known

Application Number 11/154,894
Filing Date 06/15/2005
First Named Inventor Lawrence G. Hopkins
Art Unit 3744
Examiner Name Ninh H. Nguyen
Attorney Docket Number HTR007-3C US

U. S. PATENT DOCUMENTS					
Examiner Initials*	Cite No. ¹	Document Number Number-Kind Code ² (if known)	Publication Date MM-DD-YYYY	Name of Patentee or Applicant of Cited Document	Pages, Columns, Lines, Where Relevant Passages or Relevant Figures Appear
NN	1	US- 2004/0185771A1	09-23-2004	Hopkins	
NN	2	US- 2005/0184846A1	08-18-2005	Hopkins	
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FOREIGN PATENT DOCUMENTS					
Examiner Initials*	Cite No. ¹	Foreign Patent Document Country Code ³ Number ⁴ Kind Code ⁵ (if known)	Publication Date MM-DD-YYYY	Name of Patentee or Applicant of Cited Document	Pages, Columns, Lines, Where Relevant Passages Or Relevant Figures Appear

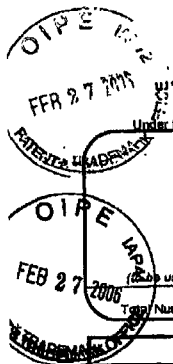
Examiner Signature	/Ninh Nguyen/	Date Considered	11/27/2006
--------------------	---------------	-----------------	------------

*EXAMINER: Initial if reference considered, whether or not citation is in conformance with MPEP 608. Draw line through citation if not in conformance and not considered. Include copy of this form with next communication to applicant. ¹ Applicant's unique citation designation number (optional). ² See Kinds Codes of USPTO Patent Documents at www.uspto.gov or MPEP 901.04. ³ Enter Office that issued the document, by the two-letter code (WIPO Standard ST.3). ⁴ For Japanese patent documents, the indication of the year of the reign of the Emperor must precede the serial number of the patent document. ⁵ Kind of document by the appropriate symbols as indicated on the document under WIPO Standard ST.16 if possible. ⁶ Applicant is to place a check mark here if English language translation is attached.

This collection of information is required by 37 CFR 1.97 and 1.98. The information is required to obtain or retain a benefit by the public which is to file (and by the USPTO to process) an application. Confidentiality is governed by 35 U.S.C. 122 and 37 CFR 1.14. This collection is estimated to take 2 hours to complete, including gathering, preparing, and submitting the completed application form to the USPTO. Time will vary depending upon the individual case. Any comments on the amount of time you require to complete this form and/or suggestions for reducing this burden, should be sent to the Chief Information Officer, U.S. Patent and Trademark Office, P.O. Box 1450, Alexandria, VA 22313-1450. DO NOT SEND FEES OR COMPLETED FORMS TO THIS ADDRESS. SEND TO: Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450.

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H 000557



TRANSMITTAL FORM

(To be used for all correspondence after initial filing)

Total Number of Pages in This Submission 4

Application Number 11/154,894

Filing Date 08/19/2005

First Named Inventor Lawrence G. Hopkins

Art Unit 3744

Examiner Name Ninh H. Nyugen

Attorney Docket Number HTR007-3C US

ENCLOSURES (Check all that apply)

- ☐ Fee Transmittal Form
- ☐ Fee Attached
- ☐ Amendment/Reply
- ☐ After Final
- ☐ Affidavits/declaration(s)
- ☐ Extension of Time Request
- ☐ Express Abandonment Request
- ☒ Information Disclosure Statement

- ☐ Certified Copy of Priority Document(s)
- ☐ Reply to Missing Parts/Incomplete Application
- ☐ Reply to Missing Parts under 37 CFR 1.52 or 1.53

- ☐ Drawing(s)
- ☐ Licensing-related Papers
- ☐ Petition
- ☐ Petition to Convert to a Provisional Application
- ☐ Power of Attorney, Revocation
- ☐ Change of Correspondence Address
- ☐ Terminal Disclaimer
- ☐ Request for Refund
- ☐ CD, Number of CD(s) _____
- ☐ Landscape Table on CD

- ☐ After Allowance Communication to TC
- ☐ Appeal Communication to Board of Appeals and Interferences
- ☐ Appeal Communication to TC (Appeal Notice, Brief, Reply Brief)
- ☐ Proprietary Information
- ☐ Status Letter
- ☒ Other Enclosure(s) (please identify below):
- Return Postcard

Remarks
Please charge any required fee to Deposit Account No. 50-2263

SIGNATURE OF APPLICANT, ATTORNEY, OR AGENT

Firm Name	Silicon Valley Patent Group LLP		
Signature	<i>David E. Steuber</i>		
Printed name	David E. Steuber		
Date	02/22/2006	Reg. No.	25,557

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Signature	<i>David E. Steuber</i>		
Typed or printed name	David E. Steuber	Date	02/22/2006

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H 000558



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 Alexandria, Virginia 22313-1450
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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
11/154,894	06/15/2005	Lawrence G. Hopkins	HTR007-3C US	2747
34036	7590	03/08/2006	EXAMINER	
SILICON VALLEY PATENT GROUP LLP 2350 MISSION COLLEGE BOULEVARD SUITE 360 SANTA CLARA, CA 95054			NGUYEN, DINH H	
			ART UNIT	PAPER NUMBER
			3745	

DATE MAILED: 03/08/2006

Please find below and/or attached an Office communication concerning this application or proceeding.

Office Action Summary	Application No.		Applicant(s)	
	11/154,894		HOPKINS, LAWRENCE G.	
	Examiner		Art Unit	
	Ninh H. Nguyen		3745	

- The MAILING DATE of this communication appears on the cover sheet with the correspondence address -

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) OR THIRTY (30) DAYS, WHICHEVER IS LONGER, FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1) ☐ Responsive to communication(s) filed on ____.

2a) ☐ This action is **FINAL**. 2b) ☒ This action is non-final.

3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

4) ☒ Claim(s) 1-20 is/are pending in the application.

 4a) Of the above claim(s) ____ is/are withdrawn from consideration.

5) ☐ Claim(s) ____ is/are allowed.

6) ☒ Claim(s) 1-20 is/are rejected.

7) ☐ Claim(s) ____ is/are objected to.

8) ☐ Claim(s) ____ are subject to restriction and/or election requirement.

Application Papers

9) ☐ The specification is objected to by the Examiner.

10) ☒ The drawing(s) filed on 15 June 2005 is/are: a) ☒ accepted or b) ☐ objected to by the Examiner.
 Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).
 Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).

11) ☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

12) ☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
 a) ☐ All b) ☐ Some * c) ☐ None of:
 1. ☐ Certified copies of the priority documents have been received.
 2. ☐ Certified copies of the priority documents have been received in Application No. ____.
 3. ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

1) <input checked="" type="checkbox"/> Notice of References Cited (PTO-892) 2) <input type="checkbox"/> Notice of Draftsperson's Patent Drawing Review (PTO-948) 3) <input checked="" type="checkbox"/> Information Disclosure Statement(s) (PTO-1449 or PTO/SB/08) Paper No(s)/Mail Date <u>06/15/05, 01/17/06</u> .	4) <input type="checkbox"/> Interview Summary (PTO-413) Paper No(s)/Mail Date: ____. 5) <input type="checkbox"/> Notice of Informal Patent Application (PTO-152) 6) <input type="checkbox"/> Other: ____
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Application/Control Number: 11/154,894
 Art Unit: 3745

Page 2

DETAILED ACTION

Double Patenting

1. A rejection based on double patenting of the "same invention" type finds its support in the language of 35 U.S.C. 101 which states that "whoever invents or discovers any new and useful process ... may obtain a patent therefor ..." (Emphasis added). Thus, the term "same invention," in this context, means an invention drawn to identical subject matter. See *Miller v. Eagle Mfg. Co.*, 151 U.S. 186 (1894); *In re Ockert*, 245 F.2d 467, 114 USPQ 330 (CCPA 1957); and *In re Vogel*, 422 F.2d 438, 164 USPQ 619 (CCPA 1970).

A statutory type (35 U.S.C. 101) double patenting rejection can be overcome by canceling or amending the conflicting claims so they are no longer coextensive in scope. The filing of a terminal disclaimer cannot overcome a double patenting rejection based upon 35 U.S.C. 101.

2. Claims 1, 12, and 16 are provisionally rejected under 35 U.S.C. 101 as claiming the same invention as that of claims 5, 1, and 31 of copending Application No. 10/806,775. This is a provisional double patenting rejection since the conflicting claims have not in fact been patented.

3. The nonstatutory double patenting rejection is based on a judicially created doctrine grounded in public policy (a policy reflected in the statute) so as to prevent the unjustified or improper timewise extension of the "right to exclude" granted by a patent and to prevent possible harassment by multiple assignees. A nonstatutory obviousness-type double patenting rejection is appropriate where the conflicting claims are not identical, but at least one examined application claim is not patentably distinct from the reference claim(s) because the examined application claim is either anticipated by, or would have been obvious over, the reference claim(s). See, e.g., *In re Berg*, 140 F.3d 1428, 46 USPQ2d 1226 (Fed. Cir. 1998); *In re Goodman*, 11 F.3d 1046, 29 USPQ2d 2010 (Fed. Cir. 1993); *In re Longi*, 759 F.2d 887, 225 USPQ 645 (Fed. Cir. 1985); *In re Van Ornum*, 686 F.2d 937, 214 USPQ 761 (CCPA 1982); *In re Vogel*, 422 F.2d 438, 164 USPQ 619 (CCPA 1970); and *In re Thorington*, 418 F.2d 528, 163 USPQ 644 (CCPA 1969).

A timely filed terminal disclaimer in compliance with 37 CFR 1.321(c) or 1.321(d) may be used to overcome an actual or provisional rejection based on a nonstatutory double patenting ground provided the conflicting application or patent either is shown to be commonly owned with this application, or claims an invention made as a result of activities undertaken within the scope of a joint research agreement.

Effective January 1, 1994, a registered attorney or agent of record may sign a terminal disclaimer. A terminal disclaimer signed by the assignee must fully comply with 37 CFR 3.73(b).

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4. Claims [1], [2], [3], [4], [5], [7], [8], [9], [10], [11], [13], [14], [15], [16], [17], [18], [19], and [20] are provisionally rejected on the ground of nonstatutory obviousness-type double patenting as being unpatentable over claims [1, 31], [1], [2], [3], [4], [7], [8], [9], [10], [21], [25], [27], [29], [1, 32], [32], [1, 43], [25], and [29], respectively of copending Application No. 10/806,775. Although the conflicting claims are not identical, they are not patentably distinct from each other because claims [1, 31], [1], [2], [3], [4], [7], [8], [9], [10], [21], [25], [27], [29], [1, 32], [32], [1, 43], [25], and [29] of the copending '775 patent application "anticipates" application claims [1], [2], [3], [4], [5], [7], [8], [9], [10], [11], [13], [14], [15], [16], [17], [18], [19], and [20]. Accordingly, application claims [1], [2], [3], [4], [5], [7], [8], [9], [10], [11], [13], [14], [15], [16], [17], [18], [19], and [20] is not patentably distinct from the copending '775 patent application claim [1, 31], [1], [2], [3], [4], [7], [8], [9], [10], [21], [25], [27], [29], [1, 32], [32], [1, 43], [25], and [29]. Here, copending '775 application claim 1 requires (A) at least six fan units (B) arranged in a fan array, (C) the fan array is positioned in an air-handling compartment; and (D) an array controller; while application claim 1 only requires elements (A), (B), (C) and (E) the air-handling compartment is positionable within a structure to condition the air of the structure. It appears that the fan array fan section of claim 1 of the copending '775 application inherently can be positioned within a structure to condition the air of that structure. Thus it is apparent that the more specific copending '775 application claim 1 encompasses application claim 1. Following the rationale in *In re Goodman* cited in the preceding paragraph, where applicant has once been granted a patent containing a claim for the specific or narrower invention, applicant may not then obtain a second patent with a claim for the generic or broader invention without first submitting an appropriate terminal disclaimer. Note that since

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Application claim 1 is anticipated by copending '775 application claim 1 and since anticipation is the epitome of obviousness, then Application claim 1 is obvious over copending '775 application claim 1.

This is a provisional obviousness-type double patenting rejection.

Claim Rejections - 35 USC § 102

5. The following is a quotation of the appropriate paragraphs of 35 U.S.C. 102 that form the basis for the rejections under this section made in this Office action:

A person shall be entitled to a patent unless –

(b) the invention was patented or described in a printed publication in this or a foreign country or in public use or on sale in this country, more than one year prior to the date of application for patent in the United States.

6. Claims 1-3, 5, 6, 9, and 14-17 are rejected under 35 U.S.C. 102(b) as being anticipated by Ray (5,701,750).

Ray discloses a fan array fan section in an air-handling system (Figs. 1-5) comprising an air-handling compartment 22 (Fig. 1); a plurality of fan units 1-4; the plurality of fan units arranged in a fan array (Fig. 1); the fan array having at least one fan unit arranged vertically on at least one other fan unit; the fan array positioned within the air-handling compartment; and the air-handling compartment positionable within a structure such that the air-handling system conditions the air of the structure (Fig. 1);

wherein the fan array fan section further comprises an array controller to inherently operate the plurality of fan units at peak efficiency by strategically turning on and off selective ones of the plurality of fan units;

wherein the plurality of fan units are arranged in a true array configuration (Fig. 1);

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wherein each of the plurality of fan units is inherently mounted in a grid system (Fig. 1);

wherein the fan array fan section further comprising an array controller for controlling the plurality of fan units, the array controller is inherently operates the fan units at a stable operating point and eliminate the surge effects;

wherein the fan array fan section further comprising an array controller for controlling the plurality of fan units, the array controller inherently controls the speed of each of the plurality of fan units to run at substantially peak efficiency;

wherein the fan array fan section further comprising an array controller for operating the plurality of fan units at peak efficiency by strategically turning on and off selective ones of the plurality of fan units.

7. Claims 1-3, 5, 9, and 14-17 are rejected under 35 U.S.C. 102(b) as being anticipated by Neidhardt et al. (4,021,213).

Neidhardt discloses a fan array fan section in an air-handling system (Figs. 1-4) comprising an air-handling compartment 22 (Fig. 2); a plurality of fan units; the plurality of fan units arranged in a fan array (Fig. 21); the fan array having at least one fan unit arranged vertically on at least one other fan unit; the fan array positioned within the air-handling compartment; and the air-handling compartment positionable within a structure 12 such that the air-handling system conditions the air of the structure (Fig. 1);

wherein the fan array fan section further comprises an array controller to inherently operate the plurality of fan units at peak efficiency by strategically turning on and off selective ones of the plurality of fan units (Fig. 4; col. 4, lines 63-67);

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wherein the plurality of fan units are arranged in a true array configuration (Fig. 1);

wherein each of the plurality of fan units is mounted in a grid system (Fig. 1);

wherein the fan array fan section further comprising an array controller (Fig. 4) for controlling the plurality of fan units, the array controller is inherently operates the fan units at a stable operating point and eliminate the surge effects;

wherein the fan array fan section further comprising an array controller (Fig. 4) for controlling the plurality of fan units, the array controller inherently controls the speed of each of the plurality of fan units to run at substantially peak efficiency;

wherein the fan array fan section further comprising an array controller (Fig. 4) for operating the plurality of fan units by strategically turning on and off selective ones of the plurality of fan units (col. 4, lines 63-67) .

8. Claims 1 and 10 are rejected under 35 U.S.C. 102(b) as being anticipated by Krofchalk (5,370,576).

Krofchalk discloses a fan array fan section in an air-handling system (Figs. 1-5) comprising an air-handling compartment 18 (Fig. 5); a plurality of fan units; the plurality of fan units arranged in a fan array (Fig. 5); the fan array having at least one fan unit arranged vertically on at least one other fan unit; the fan array positioned within the air-handling compartment; and the air-handling compartment positionable within a structure (col. 2, lines 12-18) such that the air-handling system conditions the air of the structure (Fig. 5);

wherein each of the plurality of fan units has a fan wheel diameter, wherein spacing between the plurality of fan units is less than 60% of the fan wheel diameter (Fig. 5).

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Claim Rejections - 35 USC § 103

9. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

10. Claim 4 is rejected under 35 U.S.C. 103(a) as being unpatentable over Ray.

Ray discloses all the limitations except an airway path of less than 72 inches as claimed.

Since the applicant has not disclosed that having an airway path of less than 72 inches solves any stated problem or is for any particular purpose above the fact that an airway path is required for the fan array fan section to function properly, and it appears that the airway path of the fan array fan system of Ray would perform equally well with the dimensions as defined claimed by applicant, it would have been an obvious matter of design choice to modify the airway path of the fan array fan system of Ray by utilizing the specific dimensions as claimed.

11. Claim 4 is rejected under 35 U.S.C. 103(a) as being unpatentable over Ray in view of O'connell (3,156,233).

Ray discloses all the limitations except the each of the plurality of fan units is not positioned within a fan unit chamber having at least one acoustically absorptive insulation surface as claimed.

O'connell teaches an air handling apparatus comprising a fan chamber 14, a fan 20 and a motor 26; wherein the fan chamber comprising a layer of filter medium 37 to provide sealing, vibration absorption and sound attenuation (col. 2, lines 5-11).

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It would have been obvious for a person having ordinary skill in the art at the time of the invention was made to make the fan array fan section of Ray with a layer of filter material for the purpose of providing sealing, vibration absorption and sound attenuation as taught by O'connell.

12. Claim 4 is rejected under 35 U.S.C. 103(a) as being unpatentable over Krofchalk.

Krofchalk discloses all the limitations including a back draft dampener 28 (Fig. 5) for both fan units. However, Krofchalk does not disclose an array of backdraft dampeners wherein each backdraft dampener in line with a respective fan unit as claimed.

It would have been obvious for a person having ordinary skill in the art at the time of the invention was made to make the fan array fan section of Krofchalk with an array of backdraft dampeners wherein each backdraft dampener in line with a respective fan unit as an expedience for providing backdraft dampener for the fans.

Prior Art

The prior art made of record but not relied upon is considered pertinent to applicant's disclosure and consists of 1 patent.

Osborne et al. (6,792,766) is cited to show a fan array configuration.

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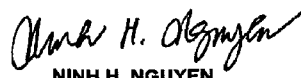
Page 9

Conclusion

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Examiner Ninh Nguyen whose telephone number is (571) 272-4823. The examiner can be normally reached on Monday-Friday from 7:30 A.M. to 5:00 P.M.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Edward Look, can be reached at (571) 272-4820. The fax number for this group is (571) 273-8300.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, please go to <http://pair-direct.uspto.gov> or contact the Electronic Business center (EBC) at 866-217-9197 (toll-free).


NINH H. NGUYEN
PRIMARY EXAMINER

Nhn
March 6, 2006

H 000568

Notice of References Cited	Application/Control No. 11/154,894	Applicant(s)/Patent Under Reexamination HOPKINS, LAWRENCE G.	
	Examiner Ninh H. Nguyen	Art Unit 3745	Page 1 of 1

U.S. PATENT DOCUMENTS

*		Document Number Country Code-Number-Kind Code	Date MM-YYYY	Name	Classification
*	A	US-4,021,213	05-1977	Neidhardt et al.	62/180
*	B	US-5,701,750	12-1997	Ray, Robert W.	62/180
*	C	US-3,156,233	11-1964	O'CONNELL ALVA D	126/110R
*	D	US-6,792,766	09-2004	Osborne et al.	62/159
	E	US-			
	F	US-			
	G	US-			
	H	US-			
	I	US-			
	J	US-			
	K	US-			
	L	US-			
	M	US-			

FOREIGN PATENT DOCUMENTS

*		Document Number Country Code-Number-Kind Code	Date MM-YYYY	Country	Name	Classification
	N					
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	R					
	S					
	T					

NON-PATENT DOCUMENTS

*		Include as applicable: Author, Title Date, Publisher, Edition or Volume, Pertinent Pages)
	U	
	V	
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	X	

*A copy of this reference is not being furnished with this Office action. (See MPEP § 707.05(e).)
Dates in MM-YYYY format are publication dates. Classifications may be US or foreign.

U.S. Patent and Trademark Office
PTO-892 (Rev. 01-2001)

Notice of References Cited

Part of Paper No. 03062006

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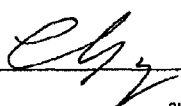


PTO/SB/25 (07-06)

Approved for use through 09/30/2008. OMB 0851-0031

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TERMINAL DISCLAIMER TO OBTAIN A PROVISIONAL DOUBLE PATENTING REJECTION OVER A PENDING "REFERENCE" APPLICATION		Docket Number (Optional) CDM/8887.9999
<p>In re Application of: Hopkins, Lawrence G.</p> <p>Application No.: 11/154,894</p> <p>Filed: 06/15/2005</p> <p>For: FAN ARRAY FAN SECTION IN AIR-HANDLING SYSTEMS</p> <p>The owner*, <u>Huntair Inc.</u>, of <u>100</u> percent interest in the instant application hereby disclaims, except as provided below, the terminal part of the statutory term of any patent granted on the instant application which would extend beyond the expiration date of the full statutory term of any patent granted on pending reference Application Number <u>10/806,775</u> filed on <u>03/22/2004</u>, as such term is defined in 35 U.S.C. 154 and 173, and as the term of any patent granted on said reference application may be shortened by any terminal disclaimer filed prior to the grant of any patent on the pending reference application. The owner hereby agrees that any patent so granted on the instant application shall be enforceable only for and during such period that it and any patent granted on the reference application are commonly owned. This agreement runs with any patent granted on the instant application and is binding upon the grantee, its successors or assigns.</p> <p>In making the above disclaimer, the owner does not disclaim the terminal part of any patent granted on the instant application that would extend to the expiration date of the full statutory term as defined in 35 U.S.C. 154 and 173 of any patent granted on said reference application, "as the term of any patent granted on said reference application may be shortened by any terminal disclaimer filed prior to the grant of any patent on the pending reference application." In the event that: any such patent: granted on the pending reference application: expires for failure to pay a maintenance fee, is held unenforceable, is found invalid by a court of competent jurisdiction, is statutorily disclaimed in whole or terminally disclaimed under 37 CFR 1.321, has all claims canceled by a reexamination certificate, is reissued, or is in any manner terminated prior to the expiration of its full statutory term as shortened by any terminal disclaimer filed prior to its grant.</p> <p>Check either box 1 or 2 below, if appropriate.</p> <p>1. <input type="checkbox"/> For submissions on behalf of a business/organization (e.g., corporation, partnership, university, government agency, etc.), the undersigned is empowered to act on behalf of the business/organization.</p> <p>I hereby declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under Section 1001 of Title 18 of the United States Code and that such willful false statements may jeopardize the validity of the application or any patent issued thereon.</p> <p>2. <input checked="" type="checkbox"/> The undersigned is an attorney or agent of record. Reg. No. <u>26,568</u></p> <p> _____ 09/08/2006 Signature Date</p> <p>Charles D. McClung Typed or printed name</p> <p>_____ (503) 227-5631 Telephone Number</p> <p><input checked="" type="checkbox"/> Terminal disclaimer fee under 37 CFR 1.20(d) is included.</p> <p>WARNING: Information on this form may become public. Credit card information should not be included on this form. Provide credit card information and authorization on PTO-2038.</p> <p>*Statement under 37 CFR 3.73(b) is required if terminal disclaimer is signed by the assignee (owner). Form PTO/SB/96 may be used for making this statement. See MPEP § 324.</p>		

This collection of information is required by 37 CFR 1.321. The information is required to obtain or retain a benefit by the public which is to file (and by the USPTO to process) an application. Confidentiality is governed by 35 U.S.C. 122 and 37 CFR 1.11 and 1.14. This collection is estimated to take 12 minutes to complete, including gathering, preparing, and submitting the completed application form to the USPTO. Time will vary depending upon the individual case. Any comments on the amount of time you require to complete this form and/or suggestions for reducing this burden, should be sent to the Chief Information Officer, U.S. Patent and Trademark Office, U.S. Department of Commerce, P.O. Box 1450, Alexandria, VA 22313-1450. DO NOT SEND FEES OR COMPLETED FORMS TO THIS ADDRESS. SEND TO: Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450.

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02 FC:1814

H 000570

Application Number 	Application/Control No. 11/154,894	Applicant(s)/Patent under Reexamination HOPKINS, LAWRENCE G.
Document Code - DISQ		Internal Document – DO NOT MAIL

TERMINAL DISCLAIMER	<input checked="" type="checkbox"/> APPROVED	<input type="checkbox"/> DISAPPROVED
Date Filed : 09/11/06	This patent is subject to a Terminal Disclaimer	

Approved/Disapproved by:
JH

U.S. Patent and Trademark Office

H 000571

SEP 11 2006

PTO/SB/22 (12-04)
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PETITION FOR EXTENSION OF TIME UNDER 37 CFR 1.136(a)
FY 2005

(Fees pursuant to the Consolidated Appropriations Act, 2005 (H.R. 4810).)

Docket Number (Optional)

CDM/8887.9999

Application Number 11/154,894

Filed 06/15/2005

For Hopkins, Lawrence G.

Art Unit 3744

Examiner Nguyen, Nihn H.

This is a request under the provisions of 37 CFR 1.136(a) to extend the period for filing a reply in the above identified application.

The requested extension and fee are as follows (check time period desired and enter the appropriate fee below):

	Fee	Small Entity Fee	
<input type="checkbox"/> One month (37 CFR 1.17(a)(1))	\$120	\$80	\$ _____
<input type="checkbox"/> Two months (37 CFR 1.17(a)(2))	\$450	\$225	\$ _____
<input checked="" type="checkbox"/> Three months (37 CFR 1.17(a)(3))	\$1020	\$510	\$ <u>1020</u>
<input type="checkbox"/> Four months (37 CFR 1.17(a)(4))	\$1590	\$795	\$ _____
<input type="checkbox"/> Five months (37 CFR 1.17(a)(5))	\$2160	\$1080	\$ _____

☐ Applicant claims small entity status. See 37 CFR 1.27.

☒ A check in the amount of the fee is enclosed.

☐ Payment by credit card. Form PTO-2038 is attached.

☐ The Director has already been authorized to charge fees in this application to a Deposit Account.

☒ The Director is hereby authorized to charge any fees which may be required, or credit any overpayment, to

Deposit Account Number 03-1550. I have enclosed a duplicate copy of this sheet.

WARNING: Information on this form may become public. Credit card information should not be included on this form. Provide credit card information and authorization on PTO-2038.

I am the ☒ applicant/inventor.


☐ assignee of record of the entire interest. See 37 CFR 3.71

Statement under 37 CFR 3.73(b) is enclosed. (Form PTO/SB/96).

☒ attorney or agent of record. Registration Number 26,568

☐ attorney or agent under 37 CFR 1.34.

Registration number if acting under 37 CFR 1.34. _____.


 Signature

Charles D. McClung

Typed or printed name

September 8, 2006

Date

(503) 227-5631

Telephone Number

NOTE: Signatures of all the inventors or assignees of record of the entire interest or their representative(s) are required. Submit multiple forms if more than one signature is required, see below.

☐ Total of _____ forms are submitted.

This collection of information is required by 37 CFR 1.136(a). The information is required to obtain or retain a benefit by the public which is to file (and by the USPTO to process) an application. Confidentiality is governed by 35 U.S.C. 122 and 37 CFR 1.11 and 1.14. This collection is estimated to take 6 minutes to complete, including gathering, preparing, and submitting the completed application form to the USPTO. Time will vary depending upon the individual case. Any comments on the amount of time you require to complete this form and/or suggestions for reducing this burden, should be sent to the Chief Information Officer, U.S. Patent and Trademark Office, U.S. Department of Commerce, P.O. Box 1450, Alexandria, VA 22313-1450. DO NOT SEND FEES OR COMPLETED FORMS TO THIS ADDRESS. SEND TO: Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450.

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 01 FC:1253

H 000572



**POWER OF ATTORNEY
and
CORRESPONDENCE ADDRESS
INDICATION FORM**

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Application Number	11/154,894
Filing Date	June 15, 2005
First Named Inventor	
Title	PAN ARRAY PAN SECTION IN AIR HANDLING SYSTEM
Art Unit	
Examiner Name	
Attorney Docket Number	CDM/8882.9999

I hereby revoke all previous powers of attorney given in the above-identified application.

I hereby appoint:

☒ Practitioners associated with the Customer Number:

00152

OR

☐ Practitioner(s) named below:

Name	Registration Number

as my/our attorney(s) or agent(s) to prosecute the application identified above, and to transact all business in the United States Patent and Trademark Office connected therewith.

Please recognize or change the correspondence address for the above-identified application to:

☐ The address associated with the above-mentioned Customer Number

OR

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OR

<input checked="" type="checkbox"/> Firm or Individual Name	Charles D. McClung		
Address	1600 QDS Tower 601 SW Second Avenue		
City	Portland	State	OR ZIP 97204-3157
Country	USA		
Telephone	(503) 227-5631	Email	chuck@chemofflaw.com

I am the:

☐ Applicant/Inventor.

☒ Assignee of record of the entire interest. See 37 CFR 3.71.

Statement under 37 CFR 3.73(b) is enclosed. (Form PTO/SB/96)

SIGNATURE of Applicant or Assignee of Record

Signature	<i>Kevin W. Donnelly</i>	Date	8/25/2006
Name	Kevin W. Donnelly	Telephone	(401) 751-1600
Title and Company	Vice President, General Counsel and Secretary - Huntair, Inc.		

NOTE: Signatures of all the inventors or assignees of record of the entire interest or their representative(s) are required. Submit multiple forms if more than one signature is required, see below.

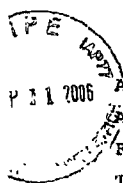
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This collection of information is required by 37 CFR 1.31, 1.32 and 1.33. The information is required to obtain or retain a benefit by the public which is to be (and by the USPTO to process) an application. Confidentiality is governed by 35 U.S.C. 122 and 37 CFR 1.11 and 1.14. This collection is estimated to take 3 minutes to complete, including gathering, preparing, and submitting the completed application form to the USPTO. Time will vary depending upon the individual case. Any comments on the amount of time you require to complete this form and/or suggestions for reducing this burden, should be sent to the Chief Information Officer, U.S. Patent and Trademark Office, U.S. Department of Commerce, P.O. Box 1450, Alexandria, VA 22313-1450. DO NOT SEND FEES OR COMPLETED FORMS TO THIS ADDRESS. SEND TO: Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450.

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H 000573

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE
CERTIFICATE UNDER 37 CFR §3.73(b)



Applicant : Hopkins, Lawrence G.
 App. No. : 11/154,894
 Filed : 06/15/2005
 Title : FAN ARRAY FAN SECTION IN AIR-HANDLING SYSTEMS
 (Assignee) : Huntair Inc., an Oregon corporation
 (Type of Assignee, e.g., corporation, partnership,
 university, government agency, etc.)

certifies that it is the assignee of the entire right, title and interest
 in the patent application identified above by virtue of either:

- A. ☐ An assignment from the inventor(s) of the patent application
 identified above.
 OR
 B. ☒ A chain of title from the inventor(s), of the patent
 application identified above, to the current assignee as shown
 below:

1. From: Cleanpak International Inc. To: Huntair Inc.
 The document was recorded in the Patent and Trademark Office at
 Reel 017586, Frame 0137, or for which a copy is attached.
 2. From: _____ To: _____
 The document was recorded in the Patent and Trademark Office at
 Reel _____, Frame _____, or for which a copy is attached.
- ☐ Additional documents in the chain of title are listed on a
 supplemental sheet.
- ☐ Copies of assignments or other documents in the chain of title
 are attached. (Where one or more of the documents is
 unrecorded.)

The undersigned has reviewed all the documents in the chain of title
 of the patent application identified above and, to the best of
 undersigned's knowledge and belief, title is in the assignee identified
 above.

The undersigned (whose title is supplied below) is empowered to sign
 this Certificate on behalf of the assignee.

I hereby declare that all statements made herein of my own knowledge
 are true, and that all statements made on information and belief are
 believed to be true; and further, that these statements are made with the
 knowledge that willful false statements, and the like so made, are
 punishable by fine or imprisonment, or both, under Section 1001, Title 18
 of the United States Code, and that such willful false statements may
 jeopardize the validity of the application or any patent issuing thereon.

Date : September 8, 2006
 Name : Charles D. McClung
 Title : Attorney for the Assignee (copy of Power of Attorney attached)

Signature: 

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Assignments on the Web > Patent Query

Patent Assignment Abstract of Title

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Total Assignments: 2

Patent #: NONE

Issue Dt:

Application #: 11154894 **Filing Dt:** 06/15/2005

Publication #: US20050232753 **Pub Dt:** 10/20/2005

Inventor: Lawrence G. Hopkins

Title: Fan array fan section in air-handling systems

Assignment: 1

Reel/Frame: 016702/0901

Recorded: 05/15/2005

Pages: 2

Conveyance: ASSIGNMENT OF ASSIGNORS INTEREST (SEE DOCUMENT FOR DETAILS).

Assignor: HOPKINS, LAWRENCE G.

Exec Dt: 03/22/2004

Assignee: HUNTAIR INC.

11555 SW MYSLONY STREET
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Correspondent: KAREN DANA OSTER

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PMB 1020, 15450 SW BOONES FERRY RD. #9
LAKE OSWEGO, OREGON 97035

Assignment: 2

Reel/Frame: 017586/0137

Recorded: 05/08/2006

Pages: 12

Conveyance: SECURITY AGREEMENT

Assignors: CLEANPAK INTERNATIONAL, INC.

Exec Dt: 04/27/2006

HUNTAIR, INC.

Exec Dt: 04/26/2006

Assignee: UBS AG, STAMFORD BRANCH, AS ADMINISTRATIVE AGENT

677 WASHINGTON BOULEVARD
STAMFORD, CONNECTICUT 06901

Correspondent: CORPORATION SERVICE COMPANY

1133 AVENUE OF THE AMERICAS
SUITE 3100
NEW YORK, NY 10036

Search Results as of 08/07/2008 00:00 P
If you have any comments or questions concerning the data displayed, contact PRD / Assignments at 571-272-3350.
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Fees pursuant to the Consolidated Appropriations Act, 2005 (H.R. 4618).		Complete If Known	
FEE TRANSMITTAL for FY 2006		Application Number	11/154,894
		Filing Date	06/15/2005
		First Named Inventor	Hopkins, Lawrence G.
		Examiner Name	Nguyen, Nihn H.
		Art Unit	3744
<input type="checkbox"/> Applicant claims small entity status. See 37 CFR 1.27		Attorney Docket No.	CDM/8887.9999
TOTAL AMOUNT OF PAYMENT (\$)		1,150.00	

METHOD OF PAYMENT (check all that apply)

- ☒ Check
 ☐ Credit Card
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 ☐ None
 ☐ Other (please identify) : _____
☒ Deposit Account
 Deposit Account Number: 03-1550
 Deposit Account Name: Chernoff, Vilhauer, McClung & Stenzel, LLP

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FEE CALCULATION**1. BASIC FILING, SEARCH, AND EXAMINATION FEES**

Application Type	FILING FEES		SEARCH FEES		EXAMINATION FEES		Fees Paid (\$)
	Fee (\$)	Small Entity Fee (\$)	Fee (\$)	Small Entity Fee (\$)	Fee (\$)	Small Entity Fee (\$)	
Utility	300	150	500	250	200	100	_____
Design	200	100	100	50	130	65	_____
Plant	200	100	300	150	160	80	_____
Reissue	300	150	500	250	600	300	_____
Provisional	200	100	0	0	0	0	_____

2. EXCESS CLAIM FEES

Fee Description	Small Entity Fee (\$)	Fee (\$)
Each claim over 20 (including Reissues)	50	25
Each independent claim over 3 (including Reissues)	200	100
Multiple dependent claims	360	180
Total Claims	Extra Claims	Fee (\$)
_____ - 20 or HP = _____	x _____	= _____
HP = highest number of total claims paid for, if greater than 20.		
Indep. Claims	Extra Claims	Fee (\$)
_____ - 3 or HP = _____	x _____	= _____
HP = highest number of independent claims paid for, if greater than 3.		

3. APPLICATION SIZE FEE

If the specification and drawings exceed 100 sheets of paper (excluding electronically filed sequence or computer listings under 37 CFR 1.52(e)), the application size fee due is \$250 (\$125 for small entity) for each additional 50 sheets or fraction thereof. See 35 U.S.C. 41(a)(1)(G) and 37 CFR 1.16(s).

Total Sheets	Extra Sheets	Number of each additional 50 or fraction thereof	Fee (\$)	Fees Paid (\$)
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4. OTHER FEE(S)

Non-English Specification, \$130 fee (no small entity discount)

Other (e.g., late filing surcharge): Petition for Extension of Time (\$1,020); and Terminal Disclaimer fee (\$130)

Fees Paid (\$)
\$1,150.00

SUBMITTED BY			
Signature		Registration No. (Attorney/Agent)	26,568
Name (Print/Type)	Charles D. McClung	Telephone	(503) 227-5631
		Date	06/28/05

This collection of information is required by 37 CFR 1.136. The information is required to obtain or retain a benefit by the public which is to file (and by the USPTO to process) an application. Confidentiality is governed by 35 U.S.C. 122 and 37 CFR 1.14. This collection is estimated to take 30 minutes to complete, including gathering, preparing, and submitting the completed application form to the USPTO. Time will vary depending upon the individual case. Any comments on the amount of time you require to complete this form and/or suggestions for reducing this burden, should be sent to the Chief Information Officer, U.S. Patent and Trademark Office, U.S. Department of Commerce, P.O. Box 1450, Alexandria, VA 22313-1450. DO NOT SEND FEES OR COMPLETED FORMS TO THIS ADDRESS. SEND TO: Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450.

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